LECTURES ON ORTHOPEDIC SURGERY

LOUIS BAUER M.D.


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LECTURES

ON

ORTHOPÆDIC SURGERY.

DELIVERED AT THE

BROOKLYN MEDICAL AND SURGICAL INSTITUTE,

WITH NUMEROUS ILLUSTRATIONS.

BY

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To

JOSEPH PANCOAST, M.D.,

PROFESSOR OF ANATOMY IN JEFFERSON MEDICAL COLLEGE, PHILADELPHIA; AND SURGEON TO THE PENNSYLVANIA HOSPITAL,

THESE PAGES

ARE RESPECTFULLY INSCRIBED AS A FAINT EXPRESSION OF HIGH PERSONAL ESTEEM AND SCIENTIFIC APPRECIATION,

By the Author.

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LECTURES

ON

ORTHOPÆDIC SURGERY.

DELIVERED AT THE BROOKLYN MEDICAL AND SURGICAL INSTITUTE.

By LOUIS BAUER, M.D, M.R.C.S., Eng.

Gentlemen:—Since the establishment of the Brooklyn Medical and Surgical Institute, quite a large number of patients afflicted with deformities have been received and attended to. The clinical material that has thus been placed at our disposal has been both considerable and instructive.

Actuated by the desire to render this institution subservient to the advancement of medical science and art, its enlightened Board of Trustees has decided to open its pathological resources to the profession at large, and to institute, during the ensuing winter, such lectures as may best tend to that result.

Having been appointed one of the lecturers, we have chosen the subject of orthopædic surgery—a comparatively new one on this continent, but, nevertheless, one of the most important and interesting branches of the healing art.

Heretofore, this subject has by no means received in this country that attention it so eminently deserves, and the professors of surgery have held out to students indifferent opportunities to become familiar with it, either theoretically or practically. While, therefore, the profession felt scarcely competent to take the responsibility in the treatment of distortions, and rather timorous to engage in it at all, the patients thus afflicted were either left without relief, or had to seek it among empyrics, pretenders, and mere mechanics.

The propriety of preferring the subject of orthopædy to any other, for the purpose assigned, can, therefore, not be questioned, and we confidently hope that some good results may accrue from our efforts, both in a professional and public point of view.

We, however, do not mean to say that this is the first attempt to render orthopædic surgery a common property of the profession. In a fragmentary form, clinical lectures have been delivered, from time to time, by Dr. Detmold, of New York, and at the present time, our esteemed friend, Prof. Lewis A. Sayre, is engaged in a complete course at the Bellevue Hospital Medical College of New York, which cannot fail to be highly instructive, and most certainly will enhance the practical efficiency of future practitioners.

Our lectures will not be entirely theoretical. The museum of this public institution is, in point of orthopædy, tolerably complete, and it will enable us to illustrate almost all the distortions by plaster casts, taken from life. We shall also embrace all clinical opportunities that may in the course of our lectures present themselves, to

exemplify diagnosis and to test the rationale of our therapeutical principles and maxims. Our respect for your valuable time will protect you against worthless speculations. We mean to be brief, and, to the best of our humble ability, practical.

The knowledge of deformities is as ancient as deformities themselves. In the sixty-second chapter, "On the Articulations," of the works of Hippocrates, we find a comprehensive sketch of club-foot, its attendant symptoms, and fragmentary but correct views of its treatment. Very little was done to advance the knowledge on that subject for many centuries. We find but scattered and imperfect ideas by Ambrose Paré, Severinus, Arcæus, Fabricius ab Aquapendente, and others.

Professor Andry, of Paris, was the first who collected the scattered information on orthopædy, put it in a tangible form, and introduced the collective title* which this branch of the healing art now bears. He attempted also to ferret out the common causes of deformities, and to establish general indications and maxims for their effective treatment. But he certainly transgressed the boundaries of orthopædic domain by including the deficiencies of the eye, ear, hair, nails, etc., thus mixing up heterogeneous subjects which had no pathological analogy to each other. Andreas Venel, of Switzerland, subsequently (1780) corrected the errors of Andry, and established the proper limits. Venel was the first who created an institution for the exclusive treatment of distortions of the human frame. From that time orthopædy began to enlist the interest and ardor of eminent practitioners, and their efforts gave it a more scientific character.

In connection with the early advancement of orthopædy, it is but just to mention with distinction the names of Brückner, Camper, Wenzel, Paletta, Scarpa, Söemmering, Delpech, Heine and others. But the greatest, and certainly most important impetus for its scientific culture, orthopædy derived from the introduction of subcutaneous myotomy and tenotomy by Stromeyer. That operation at once rendered a large proportion of deformities amenable to treatment, which before had been set down as beyond reach of surgical means. Other improvements have since followed in rapid succession.

The discovery of anæsthetics has largely aided in advancing orthopædic science, and we have now arrived at a period in which it may be safely placed alongside with other branches of scientific medicine, without detriment to their dignity and perfection.

Orthopædic surgery has for many years been a favorite subject in Germany, and her most distinguished surgeons have assiduously joined in its culture. Besides Stromeyer, Dieffenbach, Lorinser, B. Langenbeck, Robert, Berend and other prominent men have productively labored for it. In France, Jules Guérin, Major, Marjolin, Malgaigne, and Louvrier have materially aided in diffusing and improving orthopædic practice.

Dr. Little has been its chief apostle and promoter in England. Himself a sufferer from congenital club-foot, he went to Germany, and obtained relief at the masterly hands of Stromeyer and Dieffenbach. With grateful enthusiasm for the new method of treatment, and determined to extend its benefits to his fellow-sufferers, he zealously entered upon the enterprise of establishing an orthopædic hospital, in which it is but just to say he was most generously aided by his countrymen. Nobody can pass Bloomsbury Square, in London, see the noble institution, the Royal Orthopædic Hospital, and read its reports of the thousands of patients that have received therein aid and comfort, without thinking of the beneficence and great scientific merits of its founder and chief laborer.

The inestimable boon which that charity has bestowed upon the poor and helpless may best be realized in the 12,000 patients that were attended and relieved in one decennium, (1841 to 1851.) And the numerous literary publications that have from time to time emanated from the medical officers of that institution are sufficient evidences of its scientific working.

As soon as the practical requirements of orthopædic charities had thus been demonstrated, they became established in most of the great cities of the United Kingdom, and we believe it to be no exaggeration in stating that at present 12,000 patients, afflicted with deformities, receive in the course of one year gratuitous attendance in Great Britain.

In the United States the historical records of orthopædy are not so favorable. Its advancement has met with serious obstacles on the part of the profession, and all attempts at cultivating it as a specialty have, as specialties in general, been frowned down as the pretenses of quackery.

* L'orthopædie ou l'art de prevenir et de corrigé dans le enfants les deformites du corp. Paris, 1741.

As a mere subordinate branch of surgical art, orthopædy could never develop itself to that degree of perfection it has acquired elsewhere by special devotion and culture. Public and private institutions for the exclusive treatment of deformities are highly prosperous in Europe, not by virtue of their pretenses, but by the amount of actual relief they afford to patients. Besides the discipline of the patients, so indispensable for methodical and mechanical treatment, they are provided with all the facilities and requirements of an efficacious management. They have competent nurses and medical attendants, which in a private dwelling are scarcely to be obtained.

The objections of the profession to specialties are based partly on wrong premises, partly on mere notions. The country abounds with quacks and pretenders, who victimize and fleece the community at a fearful rate. There is no law that arrests their illegitimate invasion of the professional domain. They presume with impunity on the honorably-acquired character of the profession, and unscrupulously override all decency and honesty. They gather around themselves sufferers by the hundred, and are inexhaustible in their promises and schemes to delude the ignorant and credulous portion of the people. What medical art is impotent to achieve, the quacks arrogantly claim as their divine secret. Divination is their inheritance, from which the profession is obviously excluded, and Newton is the great redeemer of afflicted humanity.

But what does all this infamous business of dishonest speculators prove against the scientific and legitimate pursuit of specialties? Nothing. It certainly does not follow that specialties would undergo the same degeneration from their honest course, and culminate in pretentious quackery. In Europe this has not been the case; and the few specialties that have been fostered in our midst have certainly given no cause for apprehensions of this kind.

On the other hand, it must be admitted that the rapid advancement of medical science and art during the present century is in a great measure owing to the division of labor. Without the special investigation of Lænnec, Skoda, and Traube, our knowledge of the diseases of the lungs and heart would be in its infancy. Cramer has almost entirely created anew the pathology of the hearing apparatus. Von Graefe is assiduously at work to reconstruct ophthalmology on a physical and rational basis, and for that Augean labor he certainly deserves our admiration and support. And must we remind you of the ingenious improvements our distinguished countryman Dr. Marion Sims has wrought in one of the most fearful defects women are liable to? Read the history of the operation for Vesico-Vaginal Fistula, and you will find that his whole time has been absorbed in perfecting its technicalities. The same influence of specialty we could prove in almost every department of medical science, to remove objections so utterly groundless.

We do not, of course, advocate the establishment of specialties at the expense of medical science and independent of it. On the contrary, they should emanate from medical science; they should receive their chief maintenance from it, and return its results to the same source from whence it originated. Not as the ancient Egyptians pursued specialties *per se*, and disconnected from each other. Such a system would be prejudicial to scientific advancement, unproductive of practical results, and terminate eventually in the crudest empiricism. That system has been finally adjudicated by history, and has certainly no earthly chance of being resuscitated.

The steady progress of medical science and its already acquired magnitude will inevitably settle the pending question. Practitioners will have to choose between general superficiality and special efficacy.

With these premises, we yet hope to see the day that in this country orthopædic hospitals and institutions will spring up, where the afflicted and distorted will find ready and efficient aid.

After this opportune digression, we beg to resume our subject. If we are correctly informed, it was Dr. Detmold who introduced tenotomy into the United States. Having enjoyed the inestimable privilege of Stromeyer's personal tuition, he commenced his orthopædic career with the enthusiasm and energy of a brilliant intellect. Great must have been the inducement to that talented surgeon to cultivate as a specialty the large, undisputed, and heretofore unexplored field; and we understand that he zealously labored to render his knowledge alike useful to the deformed and to the profession. Yet the professional notions he had to encounter must have been too strong for his perseverance, and thus he had to content himself with the ordinary professional rank.

No American surgeon realized the importance

of orthopædic surgery more fully, and felt more earnest desire for its propagation, than our venerable Nestor, Valentine Mott. In his interesting "Travels in Europe and the East," (New York, 1842,) he expresses himself in the highest terms of appreciation of "this illustrious era of the healing art." Indeed, though at the eve of an eventful and useful life, and distinguished by all the honors of a grateful country, his enthusiasm was so deeply aroused as to express his determination to lend his influential aid in the erection of "an American orthopædic institution" in the City of New York, that the principles "of that inestimable science might be diffused far and wide." But even Dr. Mott yielded to professional prejudice, an enterprise which enthusiasm and "gratitude to Guerin, to his friends and country," had conceived, and which could not have failed in contributing greatly to the relief of the poor and helpless and the promotion of professional interest; an enterprise which he himself estimated as the crowning act of his long and fruitful life.

All individual efforts of other practitioners have signally failed in this direction. Their professional pride did not allow them to call upon the public for support, and professional encouragement and favor were withheld. Hence orthopædic surgery has as yet acquired no status, and is certainly not the common property of the American profession.

The term "orthopædia," first used by Andry, has been generally accepted for that subdivision of the healing art which considers the deformities of the human frame, their prevention, causes, and treatment. The etymology of the term is derived from *ορθὸς*, straight, *παιδεύω*, to educate.

Orthopædy does not include, however, all deformities, especially those of a mere transient nature, as, for instance, the deformities connected with fractures and dislocations. The malposition of the eyeball (strabismus) has been properly transferred to ophthalmology. Defects and distortions of the integuments, and their relief, form another subdivision under the appellation of plastic surgery, and so on. Thus orthopædy is strictly limited to the more permanent and not rarely congenital deformities of the skeleton and the locomotive apparatus. These deformities originate more or less spontaneously, either on account of morbid changes and actions of the nervous system, or vitiated nutrition, (rachitis.) It should, however, be borne in mind that descriptive definitions are rarely perfect, and that discrepancies must necessarily arise from an artificial grouping of diseases. Thus, for instance, the deformities caused by the cicatrices of burns, in the neighborhood of articulations, have been drawn into the orthopædic domain, simply because they most usually demand mechanical appliances to overcome their prejudicial effects.

With but few exceptions, almost all deformities of the body are of a *consecutive* character; the bones act merely as passive agents in following the traction of the muscles. The latter, in their turn, are subservient to the nervous system, reflecting all the morbid changes that may take place in that sphere. If, however, a deformity has become firmly established, and has lasted for some time, both bones and muscles undergo more or less permanent changes in form and texture, and the difficulty may ultimately become irremediable. The ligaments are, by virtue of their structure and function, not as often implicated in deformities, as bones and muscles. Sometimes they are compromised in the formation of the sclerotic tissues at the articulations; in paralysis they seem to become relaxed, and therefore facilitate an undue mobility of their respective joints. But a contraction of ligaments is a physiological impossibility. Their dimension is regulated by elasticity. They may lose that elasticity by structural changes; they may become elongated by loss of elastic fibers and excess of fat. It can, however, not be conceived how they can become shortened by any other process than sclerosis, and this presupposes local inflammation.

A most fertile source of deformities is the diseases of joints. Not so much from displacements, anchylosis, or cicatrices, as from permanent contraction of muscles. There is scarcely an articular affection that is not more or less complicated with muscular contractions, and consequently with deformity, mostly of permanent duration. The true pathological nature of these muscular contractions has only of late been recognized, and its indirect connection with the morbid process in the joint traced to *the reflex action of the spinal cord.* It is not our province to enter largely into an investigation of this most interesting phenomenon, which is so intimately connected with diseases of joints. But having taken an active part in its pathological investigation, a brief digression will be the more justifiable, as

there are still practitioners who dispute these views.

Whenever a patient is attacked with an articular disease of some violence, one of the most prominent symptoms is *attenuation of the extremity*. This symptom you will meet with in *nine cases out of ten*, and it is too strongly marked to escape attention.

In the commencement of the articular disease, the attenuation is, of course, less than in its advanced stage. In some cases the circumference of the limb is diminished one-fourth, and even as much as a third part. The waste of the member is not confined to the adipose tissue, but extends likewise to the muscles.

The next symptom in the same direction is the *general coolness* of the member, whereas the affected joint most usually exceeds the ordinary temperature of the body.

Next, *a peculiar pain* sets in, which is indeed widely different from that painful soreness that belongs to the inflamed tissues themselves, and which increases and diminishes with the progressive or regressive phases of the morbid process.

That pain is *periodic*, *intermittent*, and *nocturnal;* it seems to be independent of external causes; it appears with *the rapidity of lightning*, and passes away with the same quickness, lasting hardly long enough *to rouse the patient thoroughly* from his slumber, and is to all appearance *most intense*, judging from the shrieks the patient utters. That pain is indeed very characteristic of articular diseases. The physician meets but rare opportunities to witness its immediate manifestations, occurring, as they do, always during the night. But once heard, they can never be forgotten.

It is certainly as reliable for the diagnosis as the *peculiar tone in croup*, or the cries of a parturient woman in the third stage of labor. Having had numerous patients under our own roof so afflicted, we have had ample opportunities to observe and study that symptom.

At last, *muscular contractions* begin to show themselves, and culminate in *a series of reflex actions* of the spinal cord, in the sensitive motor and nutritive spheres of that organ.

Strange to say, the truth of these observations has been disputed with persistent obstinacy. The most trivial and superficial theories have been more readily accepted, even at this present day, than an explanation which is based on both clinical experience and physiological facts.

The attenuation of the limb was said to be the result of *long-continued rest*, and the muscular contraction as *the product of volition*. The absurdity of such an interpretation of two positive symptoms is self-evident. Local attenuation is, without exception, *the consequence of disturbed nervous action*, and invariably *greater* when the innervation is *morbidly increased* than when it is *diminished* or even extinct. These are stubborn facts, readily verified by comparing *completely paralyzed limbs* with those in a state of *reflected* muscular contraction.

As to the latter themselves, we shall find ample occasions to satisfy your minds that they are morbid products, *beyond the will and control of the patient;* nay, more, we shall be able to show that in cases of long standing, as already remarked, they become a *structural disease*, entirely independent of its direct and indirect causes. Nothing can more effectually illustrate the position we have assumed, in this question, than to place a patient thus affected under the influence of chloroform. You will find that the most profound anæsthesia is unable to relax the tenseness, of the contracted muscles, and that the knife is the only remedy left. To speak in the face of so demonstrative an *argumentum ad hominem* is simply absurd.

You will now readily understand why articular diseases are so fertile a source of orthopædic material, and why you can extend your practical utility far beyond the ordinary limits of medical efficacy, by paying close attention to the subject under consideration.

At this place we feel solicitous to inculcate a practical axiom, which you may adopt with great advantage in the treatment of articular diseases. Resort to *extension* in all *incipient contraction* of muscles depending on that cause; but beware of it in advanced cases, for you will not only fail in accomplishing anything good, but you may even risk the increase or reproduction of the disease from which such contractions originated.

Notwithstanding the great advancement in physiology, we have, as yet, to learn the detailed laws of reflex action.

We are informed that reflex motion is invariably instigated by sensation, while it is positively denied that by the excitation of motor nerves the sensitive fibers can be acted on. Facts, however, to the direct contrary, and hereafter to be adduced, stare us in the face, and allow of no denial.

Another observation in neuro-pathology is not fully comprehensible, viz., the continuance of reflected muscular contraction *beyond the termination of the pre-existing cause.* This refers both to the lesions of the joints and central diseases of the nervous system, and thus opens a wide field for attractive physiological investigation. In some instances the change of structure may account for the permanency of the contraction. But in recent cases that interpretation is not plausible.

In motor paralysis we frequently meet with contractions of single muscles, or entire groups. To all appearance, both the paralysis and the contractions emanate from the same pathological source, though differing, perhaps, in the time of their commencement. Often paralysis and contraction set in simultaneously. Sometimes the former precedes the latter by months and years, or the subsequently contracted muscles may have been previously paralyzed.

Pure reflex contraction occurs only in *healthy muscular structure.* The coincidence of paralysis and contraction is a very interesting phenomenon, and its proximate cause has greatly puzzled pathologists. The difficulties are, however, more apparent than real. Physiology discloses the means by which we may penetrate the mystery. Remember that all muscles subservient to our will are endowed with two different sets of nervous fibers. The one descending from the brain, conveying the impulses of volition; the other originating in the ganglionic structure of the spinal cord. The excito-motor innervation of the latter is, by far, the more powerful. Thus it happens that in spinal palsy the will may still prompt a muscle to a feeble action, and in cerebral paralysis contractions of muscles may take place by centrifugal or centripetal excitation.

Muscles that have lost all their excitability, and upon which the galvanic current can produce no effect, are totally incapable of contraction, either transient or permanent.

We have observed a goodly number of cases that fully bear out the proffered explanation, but consider it hardly necessary to narrate them on this occasion.

Whatever may be the cause of tonic muscular contractions, whether they be of shorter or longer duration, they are scarcely susceptible to any other remedy than the knife. This seems rather strange, that symptoms should perpetuate their existence beyond the exciting cause, yet the numerous facts in proof are so indisputable as to allow of no doubt.

Whether the contraction be perpetuated by nutritive changes of the muscular structure, preventing relaxations, as, for instance, by sclerotic tissue, changes not as yet sufficiently investigated or determined, is a question too subtle for a premature answer. At any rate, the structural explanation would fail to satisfy our mind in recent cases, unless nutrition is, indeed, more rapid in the contracted muscular structure than we have reason to believe. The idea is therefore suggested, that the interested nerves themselves participate materially in the perverted nutrition, or a habit of action is set up, determining the duration of the contraction, as is certainly the case in clonic spasm.

Respecting congenital deformities from contracted muscles, we can admit no other pathological laws than in acquired ones. The hypothesis advanced by Cruveilhier, that the position of the fœtus in utero had something to do with the former, seems to us untenable, in as far as the muscles are concerned.

Paralysis may give rise, in different ways, to deformities: First, the joints lose their firmness and support, by the relaxation of their muscles and ligaments, bending in the direction to which their surfaces may incline. This state implies complete motor paralysis, and constitutes *passive deformity.* Secondly, but one muscular group may be paralyzed, and its antagonists retain more or less power, and draw the joint to their side.

That paralysis of motion and sensation, or of either, greatly interferes with nutrition of the member, we have already adverted to. It is, however, evident to our mind that diminution of maintenance is by far more marked in palsy emanating from the spinal cord than from the brain. The difference is purely anatomical on account of the spinal nerves receiving a greater complement of fibers, from the great sympathetic system governing the organic functions.

In proportion to the sluggish nutrition in paralyzed parts of the body, stands the repair. All structural disturbances manifest a degree of venous hyperæmia, and a great tendency to sloughing. *A true, active inflammation scarcely ever takes place in paralyzed extremities,* which is but an analogue of the fact that *inflammation is never observed in the lower species of animals with an imperfect nervous system.*

In the catalogue of general causes productive

of deformities, to the *disturbance of the center of gravity* of the body has been assigned a prominent place. We shall occupy your attention in giving the subject a general consideration.

To the diligent and instructive experiments of Prof. Weber we owe the accurate knowledge of the mechanical laws engrafted upon the construction of the human frame and its locomotion.

First Experiment.—Place a board upon a wooden prism, and balance it accurately. Then place a well man horizontally upon it; you will then perceive that if both man and board are accurately balanced, the fibro-cartilaginous articulation of the last lumbar vertebra with the sacrum bone will rest upon the prism. (*Fig.* 1.)

Fig. 1.

Fig. 2.

Second Experiment.—Place a man vertically upon a balanced board on a prism, as exemplified in *Fig.* 2, and drop a plummet line laterally from above the head to the superior angle of the prism; you thus divide the body into an anterior and posterior half; and in the same way, the occipito-atloid, sacro-vertebral, shoulder, hip, knee, and tibio-tarsal articulations.

Third Experiment.—Balance a man on the prism, so that his mesian line becomes continuous with the angle of the prism, and drop the plummet line on his back; the result will be that the line divides the body into two halves, a right and a left one, and at the same time the sacro-vertebral articulation.

It follows, therefore, that at the center of that articulation, the center of gravity of the body is located.

Anything tending to increase or diminish the weight of either side of the body will inevitably throw it out of its perpendicular. Thus, the loss of one of the extremities will disturb the center of gravity. The enlargement of one of the internal organs, more especially the liver; the distention of one of the pleural sacs with fluid, or a tumor of some size on one side of the mesian line, would have the same physical effect. Inasmuch as the like causes are of a more transitory existence, and the body is in a condition to allow the change of posture, their influence upon the frame will be a temporary distortion only; if, indeed, it could be called so, and vice versa. We know patients who, for half a century, have suffered from declivity of the pelvis, on account of shortness and malposition of one of the lower extremities, and their spine is consequently thrown out of the perpendicular. If they assume the erect posture or gait, their vertebral column presents the lateral sigmoid form. Yet if they sit down, and their pelvis rests equally upon the seat, the spine becomes perfectly straight. You perceive, therefore, that the change of position counterbalances physical defects, and prevents permanent distortions of the frame.

From these facts, and numerous others which might be adduced, it follows, conclusively, that the simple mechanical derangement of the center of gravity can alone effect no permanent consecutive deformities, and that another pathological element has to come into play.

Some orthopædic surgeons, and more especially the late Dr. Buehring, of Berlin, deduce the pre-existing cause adverted to from two sources: 1st. From the *natural* deviation of the spine from its perpendicular toward the right of the mesian line. 2d. From *constitutional debility and inefficient nutrition* at certain periods of life.

With reference to the former, we have to say that the assertion is correct, in point of fact. Numerous measurements of the spinal column in healthy and otherwise well-formed persons with the plummet line, instituted by Buehring, ourselves, and others, have clearly demonstrated such a deviation, however trifling. And the fact that by far the largest proportion of lateral cur-

vatures of the spine occur toward the right, obviously strengthens the position of Buehring.

Whether that deviation is the result of the exceptional exercise of the right arm, or whether the unequal weight upon the spine by symmetry of the internal organs, increased by the diagonally acting heart, the spine is thus hammered out, as Buehring presumes, we are not as yet prepared to determine.

In reference to the second cause, we sincerely believe it to be the most prominent in the establishment of lateral curvature. In its behalf speaks clinical observation. Five-sixths of all deformities of this class occur in girls, and at the time of their change in life, when their system is somewhat deranged; when the uterine function has not as yet become well regulated; when the blood is impoverished, or even hydræmic; and when, consequently, their nutrition is insufficient. In the rugged and robust daughters of the poorer classes, lateral curvature is but rarely seen. Among the physically neglected young ladies that deformity is widely diffused. We mean not to say that other causes are not productive of the same effect, yet this we are sure of, that debility of the constitution is the most general one.

Idiopathic deformities, that is to say, deformities of a strictly local character, are few in number and rare in occurrence. The most prominent are those from burns in the neighborhood of joints.

Next we have to mention the inflammation of muscles, with subsequent *progressive* alteration of their texture, or, which has been termed by Duchenne and Remak, *progressive paralysis*. This disease implies two pathological elements: *change of structure* and *loss of tonicity*. The transversely striated muscular fibers gradually disappear, and sclerotic tissue is substituted in their place, or fatty degeneration ensues. In the one, shortening of the muscular belly and deformity is the inevitable result. In the other, the muscle is, to all intents and purposes, extinct. Fortunately, the disease is altogether rare, but few legitimate cases having been recorded. We have never had an opportunity of personally observing one.

It has been maintained that the disease may gradually invade the entire muscular system, and successively disqualify it for its physiological office, and that the uninterrupted galvanic current is the sovereign remedy. We have no personal experience on this topic, and have therefore to refer you to the respective works of Duchenne and Remak.

The preceding remarks on the causes of deformities have been purposely of a general nature. We did not intend, for the sake of completeness, to put forth things which are fully known to every practitioner, nor to enter upon causes which we have to touch upon again under the special heads of our subject.

At this point we desire to lay before you the plan we intend to pursue. The orthopædic specialty embraces subjects of mere formal connection. System cannot well be observed in the course of these lectures. We shall therefore follow the topographic order, with the exception of deformities originating in rachitis, and these will be considered under a common head.

Deformities have been divided—

1st. As to the time of their commencement:

a. Hereditary.

b. Congenital.

c. Acquired.

2d. As to their origin:

a. Primitive.

b. Consecutive.

3d. As to the system principally involved:

a. Deformities radiating from the nervous system.

b. From vitiated nutrition.

c. From the muscular system.

4th. As to seat:

a. Deformities of the extremities.

b. Deformities of the trunk, with their respective topographic subdivisions.

I. DEFORMITIES OF THE FEET.

Gentlemen:—The anatomical structure of the human foot is a most admirable and perfect piece of mechanism. Composed of twenty-six bones, fastened to, and articulating with each other, the foot combines a high degree of firmness and elasticity. It is, therefore, well adapted as a foundation for the body in the erect posture. It assumes for locomotion the manifold positions required, and preserves, under all physiological necessities, strength and reliance. To achieve so complicated an object with the greatest economy, nature has given to the foot a double arch, one between the heel and the ball of the great toe—*the longitudinal arch*—the other between the two margins of the foot supported by the heel, the capitulum of the first and the tuberosity of the

fifth metatarsal bone—the transverse arch. The two arches form a niche at the sole of the foot, thus causing its great strength. The plantar aponeurosis adds materially to the capacity of the longitudinal arch for bearing the weight of the body, and its strength prevents, under ordinary circumstances, any breaking down. The transverse arch is not so strongly supported.

The short transverse ligaments permit expansion to such a degree as to bring the fibular margin of the foot down to the floor, as can be readily demonstrated by an experiment. By placing your foot in water, and afterward standing with the entire weight of the body upon the floor, the external margin is imprinted to its full extent, and, so firmly, that a piece of paper cannot be removed from below that side, whereas the internal margin leaves no trace behind. For ordinary locomotion the toes seem to be dispensable appendices. But, if the foot is fully extended, the body being raised upon the capitula of the metatarsal bones, the toes come into play by enlarging the base. Pliny's remark, "digiti gressu solum apprehendunt," is, therefore, most appropriate.

The tibio-tarsal articulation is so constructed as to permit the approximation of the foot to the leg, (flexion,) to an angle of 78° 2″, (Weber,) and the extension may be carried to an angle of 120°. Besides flexion and extension, the foot is capable of performing other motions in which the ankle-joint takes, however, a very limited part. In the rotatory movements on the longitudinal axis, the astragalus slides a little forward. Adduction is chiefly carried out by the astragalus and the scaphoid; abduction, by the calcaneus and cuboid bones.

In greater rotations of the foot, the calcaneo-astragaloid articulation comes into operation.

The muscles affecting ordinary flexion are the *tibialis anticus* and the *peroneus tertius;* in the higher degrees, the *extensor digitorum longus* and *pollicis longus* materially aid.

A similar arrangement exists in the extension of the foot, the ordinary extensors being the muscles that terminate in the Achillis tendon, *gastrocnemius, soleus,* and *plantaris;* whereas the higher grade of extension is aided by the *tibialis posticus, peroneus, longus* and *brevis, flexor digitorum longus,* and *pollicis longus* muscles.

Adduction of the foot is exclusively effected by the *two tibiales* muscles; while abduction is carried out by the *three peronei* muscles *conjointly.*

As to the nerves supplying the different groups of muscles, Bonnet's experiments have disclosed that the peroneus nerve furnishes the motor fibers to the extensors of the toes and the peronei muscles; while the tibial nerve supplies the rest. That his observations are correct, we have been enabled to ascertain clinically.

We cannot further proceed into the details of the anatomical structure of the foot without exceeding our limits; but we request you to give them your special attention, for, on future occasions, we shall have to refer to them.

From the anatomical structure and the mechanical importance of the foot, it should be inferred that it is frequently the subject of deformity and malposition. And this is actually the case. Nay, more, they are not only the most numerous, but likewise of a stereotyped nature.

A considerable portion of pedal deformities is *congenital;* the larger number, however, is acquired. As to their remote causes, we can often trace them to troubles of the nervous system. They rarely consist in defective development of some of the bones of the foot, (Bilroth.*) Inflammation of the tibio-tarsal articulation likewise gives rise to them, through reflex action. Of a considerable fraction we know nothing positive of their causes.

For the more stereotyped deformity of the foot, the generic term "*talipes*" has been introduced and applied to all distortions from the normal position, with or without partial displacement of the articular surfaces of the tarsal bones.

According to certain malpositions of the foot, the varieties of talipes have received different appellations. If the internal margin of the foot is raised, and the toes inverted, it is called *club-foot, talipes varus;* if the plantar arch is broken down, the external margin of the foot elevated, and the toes everted, we have *talipes valgus,* or *flat-foot;* in *talipes equinus* the heel is abnormally raised from the ground, and the foot placed in permanent extension; or *talipes calcaneus,* when the foot occupies the reverse position of the latter. Combinations between the previous simple forms of talipes are respectively termed equino-varus; varo-equinus; equino-valgus; calcaneo-valgus, etc.

The exact diagnostic discrimination of the various complicated forms is a matter of great importance, and exercises a material influence

* Archive der Klinishen Chirurgie, vol. i. heft 1, Berlin, 1860.

upon the treatment to be adopted for their respective relief.

1. *Talipes Equinus.*

The semiotic character of talipes equinus is briefly as follows: the foot is more or less completely extended, and, in exceptional cases, may be placed in straight continuance with the leg. The remaining mobility is in the reverse ratio to the degree of extension; that is to say, it diminishes with the increase of the latter. The foot rests upon the ball, and chiefly, however, upon the ball of the large toe. The plantar arch is materially increased, and the toes, more especially the large one, are drawn back. The Achillis tendon is found to be extremely tense, and is rendered still more so by attempting to flex the foot. The plantar aponeurosis is likewise shortened, most likely by virtue of the plantar muscles. The extensor digitorum communis and pollicis longus are but rarely contracted, and if we find them so, it is most probably in consequence of the habitual action of those muscles to prevent the toes from interference, Figs. 3, 4.

The place which the foot rests upon is invariably covered with a thick and massive callosity. The entire extremity is greatly attenuated and arrested in its growth and development; the more so, the longer the distortion has existed. In addition, we observe sluggish capillary circulation and diminished temperature of the member, which manifest their effects more particularly in cold weather, when the limb becomes bluish red, mottled, and loses all its caloric.

The foot is of course shorter than its fellow, partly from arrested development, partly on account of the increased arch; and it is indeed very rare that it acquires its proper size. In front of the tibio-tarsal articulation, we clearly notice the trochlea of the astragalus, the superior surface of which lies almost in the same plane with the tibia. The malleoli are not sufficiently developed, and the diameter of the articular axis is generally diminished by one-eighth of an inch and more.

Though the gastrocnemius and soleus muscles are chiefly involved in talipes equinus, we have met with instances in which the entire group of extensor muscles participated in the deformity. This is particularly the case in serious lesions of the spinal cord; and once we observed it as the sequel of a fracture of the lumbar portion of the spine. Whether the tibialis posticus, the two peronei, and the flexor muscles of the toes are involved, is by no means so easy to determine,

Fig. 3.

Fig. 4.

because the tendons of those muscles are bound down to the grooves of the malleoli by serous slides, and the aponeurosis of the leg is particularly thick and strong about the ankle-joint. Sometimes the tendons have left their respective grooves and moved to the outside of the malleoli from the continuous stretch, and this may facilitate the diagnosis; but at others, we do not become aware of the difficulty until the Achillis tendon has been divided without producing the desired effect.

As a general thing, the contracted muscles have lost all susceptibility of being acted on by the galvanic current, yet their powerful extension gives rise to unbearable pain. This fact seems to demonstrate that the muscular structure is in a state of contraction to the extent of its capacity, or the substituted tissue is devoid of all contractile power. It is certain that innervation has not entirely been lost while pain can be provoked by extension.

After the division of the tendons, many months may elapse before the galvanic current makes any impression, and, in some instances, the contractility of the muscles is gone forever.

As might be expected, in talipes equinus of long standing, the bones themselves participate in the deformity. Their malformation exercises, of course, a material influence upon the prognosis

We have observed two or three cases of talipes equinus in which most of the symptoms just enumerated were wanting; and in fact all that characterized the trouble was the extended position of the foot and the retraction of the tendo-Achillis. Moreover, the extremity was well maintained, of ordinary temperature and color. The prevailing cause proved to be *arrest of growth* of the extremity from unknown causes, and the patients had extended the foot in order to elongate the limb and to walk with greater facility. In course of time, they had lost all volition in reference to the extensor muscles, which became fairly contracted, and the malposition belonged undoubtedly to talipes equinus. It would be unwise to interfere in those cases. In all respects, the position of the foot is serviceable, and certainly preferable to a high boot.

Talipes equinus is but rarely congenital; most usually it is *acquired*, and *depends on affections of the spinal cord and its investments*. We have exceptionally observed talipes equinus as the consequence of posterior curvature of the spinal column, of fracture of the first and second lumbar vertebræ, and once, of a wound in the back. The injury was inflicted near the tenth dorsal vertebra, by a strong-bladed knife. From the fact that the knife stuck fast, and was removed with difficulty, it seems to be justifiable to infer that the blade had entered the bone. The wound closed without delay. A few days after the accident, the patient, a strong man of about thirty-five years, was attacked with what seemed to be severe cramps in his left calf, which eventually terminated in tonic contraction of the entire group of extensors of the foot, and in a high degree of talipes equinus.

It is rather interesting to observe the process by which talipes equinus is superadded to the already existing paraplegia. We remember a few cases in which the paralysis of the lower extremities had existed some years without any change, when suddenly, and without apparent cause, the patient was attacked with severe rigors, lasting for some hours. During the same time the patient noticed painless contractions of the extensor muscles of the foot, which became permanent, and gave rise to extreme talipes equinus. In other cases of paraplegia, the commencement of talipes equinus initiated a partial return of sensation and motor power, as in the case of fracture of the spine.

In regard to the *prognosis* of talipes equinus, we have to consider the deformity *per se*, and the nature of its cause. The former is comparatively trifling unless the tarsal bones are so much malformed as to prevent or aggravate their readjustment, which, however, is not so often the case.

As a general thing, you have to deal only with the contracted muscles, and division is the sovereign remedy. But if the case has existed from infancy, the bones have in form accommodated themselves to their abnormal position, the tibio-tarsal articulation is crippled, then the prognosis is rendered doubtful, and the case may be even irremediable.

In order to accomplish a cure, both malposition and malformation of the tarsal bones have to be corrected, which, at best, is a slow process, and, as already stated, may not be accomplishable at all.

The second point that enters upon our prognostic consideration is, the proximate cause of the trouble. We may have succeeded in removing the deformity by appropriate measures, and in keeping the foot by mechanical appliances in proper position.

This is but palliative relief, and is not a cure.

In order to achieve success, you have to re-establish proper innervation of the afflicted extremity, promote its nutrition and development, and give tone to the muscles. Such a result we are mostly debarred from accomplishing, however assiduously and perseveringly we may advance with our auxiliaries, and therefore we should be guarded in our prognosis, and promise no more than we are capable of realizing. In children, however, the prognosis of talipes equinus is more favorable, for it has been observed that with the relief of the distortion, the nutrition, growth, and development become improved. It must not be forgotten, however, that the extremity very rarely keeps pace with its fellow.

2. *Talipes varus. Club-foot.*

Simple club-foot is rare. That deformity which is generally designated as club-foot is a combination of varus and equinus.

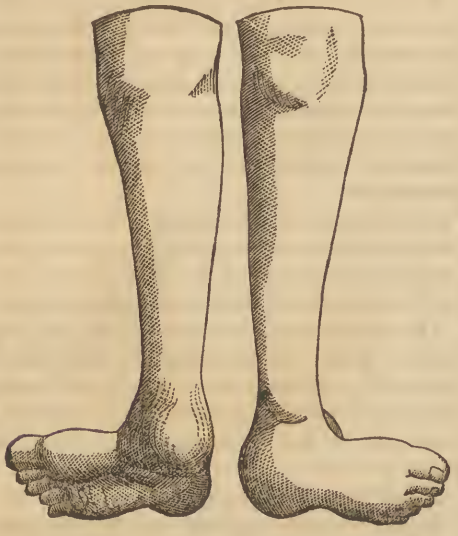
Varo-equinus is a frequent deformity. There is hardly a community, however small, among which could not be found one or two cases. Most usually it is of *congenital origin*, and very seldom acquired. If so, club-foot is superadded to pre-existing talipes equinus, and paralysis of the peronei muscles.

The anatomical derangement in club-foot is

somewhat complicated. We shall discuss it at some length, in order to render it more comprehensible.

In the specimen before you, Eigs. 5 and 6,* representing the highest grade of club-foot, and taken

Fig. 6. Fig. 5.



from a man twenty-seven years of age, you notice most of the general symptoms enumerated under the head of equinus, viz., *attenuation* of the extremity, *arrest of growth* and *development*. And what you cannot perceive in this plaster cast, we may be allowed to add: *loss of temperature, mottled appearance, etc.* The difference in the length of this extremity and that of its fellow amounted to *three inches* at the end of a three years' and at last successful treatment. In placing the cast into the same position in which the patient used his deformed member, you can realize the full extent of the distortion.

You notice thus, that the foot is longitudinally so turned, that its external margin stands on the floor, whereas the internal margin is uppermost. The foot touches the ground a little anteriorly from the external malleolus, where, from pressure, *a large callosity* has formed. Again, you observe that the back of the foot has a *forward*, and the plantar surface a *backward* direction, which, of course, implies *inversion of the toes.*

In comparing this with another cast, derived from valgus, you perceive the *directly opposite condition.* In varus, the dorsum has been *elevated* and rendered more *convex;* in the other, the dorsum is almost *flat.* In the former, the plantar arch is *greatly increased;* in that of valgus it is *entirely broken down,* so that no arch at all remains, and the tarsus comes in contact with the floor. Furthermore, here is an *inflexion* or *infraction,* noticeable at the internal margin, which has the effect of *approximating heel and large toe;* in valgus, the infraction comes from the external margin, and, in the highest grade of this deformity, tends *to bring the heel nearer to the small toe.* In our case, the cuboid, the anterior portion of the calcaneus, and the tuberosity of the fifth metatarsal bone protrude; in the other, as stated, it is chiefly the scaphoid bone.

We now propose to investigate the morbid anatomy of club-foot, the result of which has practical bearing upon its treatment. The conflicting statements of authors on the pathologico-anatomical condition of club-feet, derived from autopsy, seem to be strange to the inexperienced; not so, however, to those who have given some attention to the subject. There is a great *variety* in club-feet, which necessarily must present somewhat *different anatomical aspects.* The greatest difference accrues, however, from the *duration* of the deformity.

In most infantile club-feet, the difficulty merely seems to consist in contracted muscles, and as soon as that has been overcome the bones may be reduced to their proper relation. This, however, is scarcely possible in club-foot of long standing, having served already in locomotion. In those, we find the malposition of the foot much greater, and the bones themselves materially altered in shape. With this explanation, we shall readily reconcile the apparently contradictory reports of Glisson, Camper, Joerg, Clossius, McKeever and others on one hand, and those of Paletta, Cruveilhier, Loeb, Tourtual, Little, W. Adams, Weiss, and Brodhurst on the other. The results of the anatomical investigation of the former resolve themselves in the following aphorisms:—

1. That the primitive formation of the bones is unnatural and incomplete.

2. That the bones, being originally imperfectly formed, become injured and distorted by causes independent of the formative process, viz., by pressure, occasioned by the fœtus drawing the limbs into unnatural positions; by an improper situation of the fœtus in the uterus, or by certain ligaments becoming elongated, and the articula-

* The same specimen in the posterior aspect.

tion distorted, from contraction of some of the muscles and relaxation of others.

3. That, whatever may have been the condition of the bones on the occurrence, the act of walking displaces and injures them.

Glisson and Camper ascribe varus chiefly to malformation, and even destruction (?) of the *astragalus*, and hence they pronounce it incurable; Blumenbach,* to an *unnatural shortness* of the neck of the same bone; Naumburg† and Wenzel,‡ to both *malformation* and *displacement;* Bruckner, to *partial dislocation* of the tarsus. The observations of the just-named authors refer, of course, *to old and advanced cases alone.*

Scarpa§ seems to have examined a younger subject with club-foot; for he observed only *slight deformity* of individual tarsal bones. The scaphoid, cuboid, and calcaneus were displaced; whereas the astragalus was *least affected*, and in *almost proper situation.*

W. Adams‖ has recorded the dissection of two cases of infantile varus, to the effect that there are but *immaterial changes* of the tarsal bones, and in this respect fully confirms the views of Dr. Little: "The deviation of the os calcis is next in extent to that of the navicular bone." In a sound foot, the round head of the astragalus is principally supported by the inferior scaphoid ligament. In severe varus, however, the anterior extremity of the os calcis is forced inwardly as far as the round head of the astragalus, and occasionally beyond it, taking the office of the calcaneo-scaphoid ligament; the posterior extremity of the os calcis is consequently directed outward, toward the fibula.

Dr. Little, in his lectures,¶ gives the following information of the skeleton of club-foot:—

"An examination of these drawings, Fig. 7, will illustrate the position of the tarsal bones in complete varus. The os calcis is drawn upward; the tibial articular facets of the astragalus and its round head are exposed upon the dorsum of the foot; but the scaphoid, cuboid, cuneiform, and metatarsal bones are not merely drawn toward the sole, but also inward and upward, (and sometimes backward;) so that the innermost point touches the internal malleolus, and has an articular facet formed on it, occasioned by contact and friction. The superior and external surface of the cuboid is somewhat separated from that of the os calcis; whereas the plantar surfaces of these bones are turned toward each other, leaving a space betweenthem externally."

Fig. 7.

And again, Little says:—

"An attentive study of anatomy, in talipes varus, will further confirm the opinion of its origin, *that the muscles are the parts primarily involved.* If the bones were simply arrested in their development, or if they had been injured by external causes, and the contraction of muscles were but secondary, the bones would not bear so precisely a relation to the action of the muscles inserted into them. The preparation from which the drawings are taken shows that the shortening of the gastrocnemius muscle corresponds to the elevation of the heel, while the adductor and the remaining muscles on the posterior and internal surfaces of the ankle have drawn the navicular, cuboid, cuneiform, and metatarsal bones upward and posteriorly away from the astragalus, exposing its round head. In fact, the conjoint powerful action of the gastrocnemius and the other has bent the foot at *the summit* of its tarsal arch, drawn its component parts asunder while the ligaments were yet soft."

The anatomical relations of the tarsal bones are delineated with much more plainness and accuracy by our esteemed friend Bernhard E. Brodhurst,* than by either of the preceding authors. Brodhurst says the os calcis occupies almost a *vertical position*, being drawn upward by the gastrocnemius muscle, and is also slightly *rotated outward.*

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*Geschichte und Beschreibung der Knochen. Göttingen, 1786.

†Abhandlung von der Beinkrümmung. Leipzig, 1796.

‡Dissertatio inaug. de talepedibus varis. Tubingen, 1798.

§Memoria chirurgica sui piedi torti congeniti dei fanciulli e sulla maniera, etc. Pavia, 1803.

‖Transactions of the Pathological Society. London, 1852.

¶On the Nature and Treatment of the Deformities of the Human Frame. London, Longman, 1853, and copied from Little.

*On the Nature and Treatment of Club-Foot. London: John Churchill, 1856.

The astragalus follows the calcaneus, and is slightly rotated outward; it also undergoes displacement in its vertical axis; its inner surface tending to assume a direction forward and its external surface a direction backward, and by reason of its position between the malleoli, they are carried along with it, the internal malleolus being moved forward and the external backward. The superior articular surface of the bone is imperfectly covered by the tibia; indeed, it may remain entirely uncovered and be thrown forward on the dorsum of the foot. The astragalus being articulated with the os calcis, is slightly rotated together with it. It undergoes consequently a twofold displacement—*first, in its long axis*, through its attachments with the calcaneus; and *secondly, in its vertical axis*. The scaphoid bone is drawn in and upward, and its tubercle may be in contact with the internal malleolus. And the cuboid with the cuneiform bones, as well as the metatarsus and phalanges, necessarily follow in the abnormal direction.

With the anatomical observations of Brodhurst strictly accords not only the aspect of club-foot, but also the effect of the contracted muscles. A mere glance at the position of the heel in our specimen renders it evident that the posterior extremity of the calcaneus has *yielded inwardly* to the perverted action of the triceps, at the same time turning the bone slightly on its longitudinal axis, which the astragalus is forced to follow; whereas both Little and Adams erroneously state the direct reverse. It commonly happens that, if for some cause or the other, a muscle or its tendon is forced in an abnormal position, its action is thereby misdirected. Thus in club-foot, the adduction of the foot by the tibiales muscles displaces inwardly the insertion of the Achillis tendon, and the subsequent action of the triceps must necessarily tend to increase the adduction. On the other hand and in valgo equinus, the triceps muscle is converted into an abductor, co-operating with the peronei muscles. If either the tibialis posticus or peroneus longus and brevis leave their respective grooves behind the malleoli, they may eventually be turned into flexor muscles of the foot, instead of extending it. And once we observed the lateral displacement of the quadriceps femoris by distended subcrurœan bursa, which caused that muscle both to bend and to knock-knee the extremity.

In as far as morbid anatomy may be relied on, the evidence seems to be conclusive, that in club-foot there is *no original malformation or defects* of the tarsal or metatarsal bones. From this well-established rule but a few exceptions have recently been placed on record by Professor Th. Bilroth.

One case constituted pes varus of the highest grade of the right foot and pes varo-calcaneus of the left. The patient died from pneumonia, fourteen days after birth, when it was ascertained that the deformity of the right foot had been caused by the *absence of the entire tibia*, whereas the left presented the ordinary condition. In the right extremity the muscles of the inner side of the thigh inserted partly into the capsule of the knee-joint, partly into the aponeurosis of the leg, causing thereby permanent flexion of the knee. The patella presented an oblong form; there was no ligamentum patellæ. The capsule of the knee-joint was normal; the ligamentum laterale internum being absent. The fibula partook, with a dorsal surface, in the formation of the knee-joint, and was so loosely connected as to allow dislocation. In place of the cruciated ligaments there were but parallel folds of the synovial membranes.

The triceps muscle of the calf, tibialis posticus, and flexor digitorum communis longus considerably shortened. The flexor pollicis longus and tibialis anticus were entirely wanting. The tibialis posticus and flexor digitorum com. long. originated from the aponeurosis cruris, the rest in part from either the latter or the fibula, which was of ordinary size. Nerves and vessels normal in number and course.

The other case was observed in a female and well-grown child, nine months old. The left foot presented *defect of fourth toe, fifth metatarsal bone*, and *internal malleolus*, and had the malposition of valgus, the triceps muscle of the leg, and peroneus longus being contracted.

With the exception of these cases, we know no other similar defects of the bones of the leg and foot as the cause of malposition; and the most complete works on malformation, of Cruveilhier, Von Ammon, and Vrolik, are entirely silent on the subject. The only allusion we find in Robert is a case of Duval's, comprising a defect of the fibula.*

Having thus from post-mortem appearances conclusively ascertained the fact that, as a general thing, the contractions of muscles are the

* Des Vites Congénitaux de Conformation des Articulations, page 34.

chief, if not the sole cause of talipes varus, it remains now for us to show which muscles are involved in the malposition.

First and foremost we have to mention the *triceps surœ*, (gastrocnemius, soleus, and plantaris,) which, through the Achillis tendon, have a common insertion in the tuberosity of the calcaneus.

At first sight it does not seem as if the triceps muscle was contracted at all. This comes from the rotation of the foot, by which the points of insertion of that muscle approximate each other. In order to show its full contraction, it would be necessary to reduce the rotation, which, of course, cannot be effected without first dividing the adductor muscles of the foot. This counterpoise seems to be the reason why the triceps muscle can never attain so great a retraction in varus as in equinus, for *the greater the extension of the foot, the less possibility exists of rotation, and vice versa.*

The idea has been prevalent among some surgeons, that the triceps was the chief, if not the exclusive cause of varus, and they have consequently contented themselves with dividing the Achillis tendon as a sufficient remedy.

This is, however, erroneous, both in a theoretical and clinical point of view. The movements of our own feet clearly denote the triceps extensor muscle as designed to raise the heel and to lower the toes. For this reason the Achillis tendon descends to the heel in a central position, equally distant from either malleolus. In club-foot, to a certain extent, the triceps is converted into an *adductor muscle;* that is to say, that after the Achillis tendon has been pulled more inward from its normal position in the axis of the leg, it cannot fail in assisting the prejudicial action of the tibialis muscles in adducting and rotating the foot. Club-foot, being dependent on abnormal pronation and extension of the foot, can, of course, not be completely overcome by the division of but one group of muscles. And gentlemen indulging in those erroneous views often experience some serious trouble with reference to the tuberosity of the fifth metatarsal bone, which, they say, becomes very painful. The secret resolves itself in the fact that the division of the Achillis tendon alone does not overcome the inward rotation of the foot, and does not diminish the tarso-metatarsal infraction, and that consequently the external margin of the foot still touches the ground at the said tuberosity, causing pressure and pain. The most conclusive disproval of the aforesaid error is talipes equinus itself. We leave it to those surgeons to conciliate their views with that pathological and rather stubborn fact.

Next to the triceps, the *two tibiales muscles* are implicated in this deformity. The tibialis posticus is sometimes so much contracted as to be forced out of its groove from behind the internal malleolus, and to appear outside or even in front of the latter, becoming actually, therefore, a flexor muscle of the foot. The tibialis anticus is generally the tenser adductor; the displacement of its tendon is noticed toward the front of the foot. The shortening of both or either of the tibiales muscles is *the cause of the rotation of the foot.* If their contraction is not the same in amount, the shorter tibialis will so much obscure the longer as to make its implication dubious. But as soon as the former has been divided, the contraction of the other becomes at once apparent. At last most of the plantar muscles are contracted; their shortening accounts for the longitudinal contraction of the foot and the increase of the plantar arch. We scarcely need specify them, inasmuch as most of them constitute one bundle, with the plantar aponeurosis.

The inversion of the toes in club-foot does not exclusively depend on the malposition of the foot in the tibio-tarsal articulation, nor on the infraction of the same, but conjointly on the two, and on *the rotatory looseness of the knee-joint allowing the tibia to turn on its axis.* That this is *a fact*, you can readily ascertain by taking a firm grasp of the thigh and foot and turning the articular faces of the knee-joint upon each other. That *relaxed condition of the knee-joint* generally continues for a long while, and even beyond the actual treatment and amendment of the deformity, so that the patient may still invert his toes with his well-formed foot. It requires, therefore, our special attention, lest we might risk the return of the original difficulty.

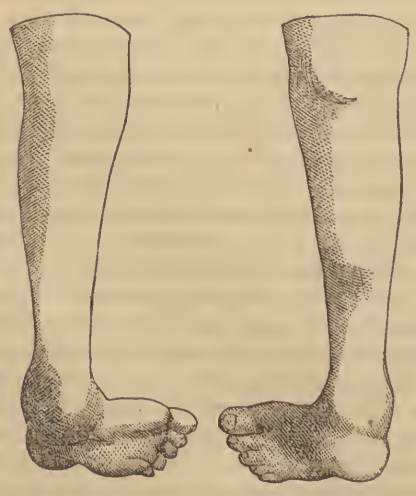
Another inconvenience may result from the undue mobility of the knee, namely, *posterior inflexion* of the knee-joint. In ordinary varus this does not often occur, whereas it is more frequent in the lower grades of equino-varus, in which the extension of the foot exceeds the rotation. The patient resorts to posterior inflexion as an *expedient* to approximate the points of insertion of the triceps, and to bring the heel to the ground.

The four specimens of talipes varus which we now exhibit illustrate different grades of the deformity. The one of a child, but a few months old, shows the least; the next, that of a boy seven years of age, Figs. 8 and 9, is essentially

Fig. 9. Fig. 8.

equino-varus—that is to say, extension of the foot prevails, presenting but a moderate deformity although it has served for locomotion all the time, and confirming, therefore, the axiom we have tried to inculcate, that the greater the extension, the lesser the rotation of the foot; the

Fig. 10. Fig. 11.



third, the most *complete varo-equinus* (Figs. 10 and 11) you ever can meet, is derived from a girl twelve years old; and the last, Figs. 5 and 6, as already stated, belongs to a man who was twenty-seven years old when he came under our charge. The last we almost completely relieved, whereas Fig. 10 received but little benefit at our hands, it being the most obstinate case we ever took charge of, from the fact that the bones had become greatly changed in their respective forms.

We deem it, for the practical objects of our lectures, entirely unnecessary to qualify different degrees of talipes varus, or lose any time with the mixed forms. In knowing the fundamental forms, you cannot fail to discern their complications.

The specimen upon the table will also enable you to form an idea as to the *awkward gait* of persons thus afflicted, and by bearing in mind that the deformity is still more aggravated by the *unequal length* of the extremity, you will realize the serious impediment in both appearance and locomotion of the patient. The preceding remark does not, of course, apply to double club-foot, in which the length of both extremities is mostly the same, and in which the walk is differently impeded.

As to the *usual causes* of club-foot we have *no positive knowledge.* Of the 1218 cases of talipes enumerated by Lonsdale,* 688 were congenital varus. That figure informs us first of *the frequency of talipes varus,* being more than 50 per cent. of all deformities of the feet; and secondly, of their *congenital origin.* But what the cause of congenital varus actually is, we do not know. Some authors have indulged in the speculation that the position of the fœtus in utero is not unlikely the prominent source of club-foot.

It seems hardly necessary to refute that hypothesis of Cruveilhier, as its fallacy is almost self-evident. The uterus is, for the average fœtus of six and a half pounds in weight, a rather limited space, and it has therefore to accommodate its form to the uterine cavity, the limbs being drawn up to the body and the plantar surfaces turned toward each other. This position the fœtus maintains even for some time after birth. If that was a sufficient cause for club-foot, almost every child would exhibit it; in fact, since the uterine position is a common one, varus should be the normal form of the foot.

The statistical tables of Duval, if, indeed, they

* Medical Gazette. London, 1849.

are at all necessary in aiding our daily observations to the contrary, prove that but one club-foot occurs in a population of 3000 in France.* Certainly this does not speak in favor of Cruveilhier's theory. Moreover, the lower extremities in general participate in the crooked position of the fœtus in utero, without their becoming deformed. And, in fine, the anatomical conditions in club-foot demonstrate that the bones are not acted on by the uterus; and upon the muscles it can scarcely be presumed to have any lasting influence. We can well comprehend that the position of the fœtus may for a short time prevail, but that would not be termed club-foot, since by mere manipulation we succeed in correcting it.

Delpech traces club-foot to arrest of development, and he endeavors to render his suggestion plausible by referring to an incidental coexistence of club-hand, hare-lip, cleft-palate, and other defects, with club-foot. But the anatomical condition of the latter is the best answer to such untenable speculations.

After mature deliberation, we have come to the conclusion that the cause, in congenital as well as in acquired club-foot, is pre-eminently defective innervation, and there is truly no reason why derangements in the nervous system should not take place in the fœtus as well as in a newly-born child. In club-foot the tibial nerve is the bearer of the difficulty, as must be inferred from the experiments of Bonnet.

The acquired instances of club-foot are comparatively rare, and they depend most unquestionably on impediments and lesions of the spinal cord. We can discriminate two forms of acquired varus. The active form is the less frequent, consisting in reflex action in both extensors and adductors. The extensors most usually preponderate, and we see therefore equino-varus. And the passive form as a sequel of motor paralysis.

The general experience on club-foot, etc. has settled the previous doubts. It is now generally admitted that all forms of varus are caused by either muscular contraction or motor paralysis, and that the individual bones of the foot yield only so much in their respective positions as they are forced to do by the abnormal muscular traction and the superincumbent weight of the body. But being held for some time and acted upon in that preternatural position, they gradually mould themselves accordingly, and become consequently malformed. That this is less the case in the lower grades of malposition of this kind and more in aggravated deformities of the foot, must be self-evident, and requires no further proof.

The prognosis of club-foot is governed by the same general considerations as that of talipes equinus. It should, however, be remembered that in the latter we have rarely to contend with any malformation of the bones. At any rate, the local obstacles to reformation and reposition of the foot are of a simpler nature. The same holds good also in recent cases of varus, in which the prognosis is comparatively favorable. But the higher grades of club-foot already used for locomotion are certainly severe tests for the patience, endurance, and perseverance of both the surgeon and his client; and years may be required to achieve a moderately good form and position of the foot, while the attenuation and impeded growth of the extremity may even remain in *statu quo*.

The age of the patient is thus far of prognostic importance, as it implies both previous locomotion of the distorted extremity and increasing hardness of the bones. We have, however, observed some exceptions to that rule, and found some of the specimens of varus of more advanced age more manageable than in younger individuals, the grades being the same.

In general, however, talipes varus constitutes a formidable and variously complicated deformity, and its eventual relief an object of skill and tact of the surgeon. We have purposely emphasized this remark in order to counterbalance the still-prevailing opinion of some practitioners, that club-foot was a distortion readily overcome by dividing the Achillis tendon and applying Scarpa's shoe. The want of experience qualifies such an assertion, and we have good reason to believe that in so comfortable a way not one single club-foot has ever been cured.

Whenever a case of talipes varus is placed under your charge, we should advise you to weigh carefully in your mind all its constituting difficulties: its degree, the condition of the bones, the state of the extremity in general, the age of the patient, and the determination of the latter or the relatives to have the cure accomplished; for their good-will is certainly indispensable to the ultimate result. And according to all this, shape your prognosis. In doing so, you will protect yourself against insolence and disappointment.

* Traité Pratique de Pied. Bot., 1834.

3. *Talipes Valgus, or Flat-foot.*

The latter term has been given to this deformity on account of the breaking down of the plantar arch, and the more or less complete flattening of the plantar surface which comes in contact with the floor at almost every point. In the higher grades of paralytic valgus, the foot may be turned on its longitudinal axis so much as to convert the internal margin into the sole, Fig. 12.

Fig. 12.

Valgus is the most frequent deformity of the foot, from the fact that, irrespective of the other morbid causes, it is evidently the inheritance of the African race. It is indeed so common among negroes as to constitute the normal type. Sometimes it is associated with knock-knee. Next to the negroes, valgus is very often met with among the Jews, more particularly in those countries where their race is preserved by the legal prohibition of intermarriage with Christians.

Besides this hereditary origin, we observe this deformity as a frequent result of diseases of the spinal cord, or, as it sometimes appears, from an exclusive paralysis of the tibial nerve.

A small, fractional part of the cases of valgus is to be attributed to inflammation of the ankle-joint. If not mistaken, we were the first who called attention to the fact that morbid reflexion was the proximate cause of that symptom.

Anatomically speaking, valgus exhibits diminution of the arched arch of the foot. The otherwise receding tibial margin of the same, protrudes to a greater or less degree. In looking down upon flat-foot it seems to be infracted in two directions—first, from upward downward; second, from the external margin toward the internal. The anatomical relations are consequently reversed. The foot is rotated on its longitudinal axis to such an extent as to lower the internal margin and raise the external. In the higher degrees, and in long-established cases, the patient may step upon his tibial margin, and, more especially, upon the protruding scaphoid bone. If there be a great relaxation of the internal lateral ligament, as is usually the case, and the articulation be loose, the astragalus is somewhat turned and inwardly inclined so as to constitute a subluxation. The infraction of the foot seems to be placed between the first and second rows of the tarsal bones. The toes are everted and the external malleolus buries its contours in the external tarsal fossa. As a general thing, the extremity is attenuated and, when paralysis is the cause of the deformity, is arrested in development so as to differ in length with its fellow To a certain extent, however, the difference must be ascribed to the altered form of the foot itself, which loses in its height from one-quarter to three-quarters of an inch.

We have already indicated the causes of the trouble, and assigned to maladies of the nervous system the greater share. It is indeed remarkable that apparently moderate affections of the brain and spinal cord during dentition should give rise to so serious consequences. In hundreds of cases we have had under our charge, at least 90 per cent. could be traced to the dentitial period, and in the larger proportion the premonitory symptoms were so insignificant as to be entirely disregarded by parents. Sometimes there was but a slight catarrh of the respiratory or alimentary organs; at others, it was preceded by great uneasiness. Many children have been put to bed in an apparently healthy condition, and taken up next morning paralyzed. In a few cases, inflammation of the meninges of the brain or spinal cord had given rise to the paralysis, which was then of a more extensive character, involving either one side of the body, (hemiplegia,) or the lower half, (paraplegia;) and in these cases talipes valgus is but one of the resulting deformities. In paraplegia, depending on direct pressure of the spinal cord by the posterior curvature of the spine, talipes valgus is rarely observed, whereas, we have met with equino valgus in fractures of the spinal column at its lumbar portion.

In all these paralytic or passive forms of

valgus we find the tibial nerve, and consequently the adductor muscles of the foot, completely paralyzed, while the peroneal nerve has retained in part or *in toto* its innervation, or it causes a state of reflex contraction. In the former, the abductor muscles are only physiologically contracted, on account of the antagonistic muscular group being disabled; in the latter, reflex action has established a tonic and permanent contraction of the peroneus muscles. The difference between these two forms of active and passive valgus can be easily discerned by substituting the hand for the physiological action of the two tibial muscles. If the foot can be brought in this way into a correct position and held there by mechanical means, you have the passive form of valgus, and *vice versa*.

Talipes valgus, originating in inflammation of the tibio-tarsal and tarsal articulations, is always of an active character, depending invariably on reflex contractions of the peroneus muscles. Not every inflammatory process in those joints necessarily gives rise to this deformity, but when they do, it is invariably valgus. From an extensive field of clinical observation, we have elicited no exception, and never met with a reflex contraction of the tibial or any other muscle of that region. In paralysis, we have incidentally observed reflex contractions of the flexores digitorum.

The lightest forms of talipes valgus are those of a consecutive mechanical character, as in genu-varum; but they are, nevertheless, very troublesome, painful to a high degree, and may even lead to inflammation of the tarsal bones.

The prognosis of valgus is governed by its producing causes. Generally the paralytic forms allow of only a doubtful prognosis. The more complete and extended the palsy, the less the hope of recovery. Progressive improvement of the principal disease, increases the chances in behalf of the valgus. We may amend the distortion and render locomotion more easy by mechanical appliances, but, of course, this does not constitute a cure. Because we cannot restore by these remedies the altered structure and lost tonicity, nor directly invigorate the arrested growth and development. In fact, beyond replacing and keeping the tarsal bones in their respective positions, and supporting the plantar arch, we can do nothing by orthopædic treatment. For these weighty reasons our prognosis should be cautiously given.

It is certainly true that paralytic affections in children, are not of so grave a nature as in adults and in people of more advanced age. Their powers of repair are greater: the skull and spinal column is yet soft or more pliable, and hence spontaneous improvements are frequent. Notwithstanding all this, a perfect recovery from paralytic valgus is one of the rarest occurrences. The more recent a case is, the more early a general and local treatment is resorted to, and the more limited the paralysis, the more favorable, certainly, is the prognosis.

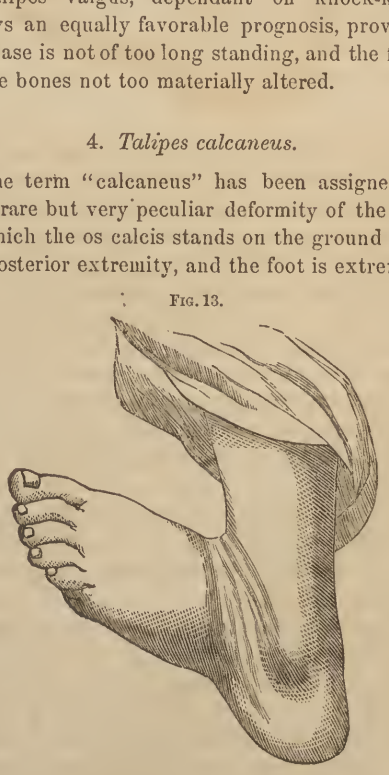
Talipes valgus produced by an inflammation of the tarsal and ankle joints admits of a favorable prognosis, at least in as far as the deformity is concerned, and in general if the inflammatory process has not too deeply involved the interested structures. The division of the peronei muscles and the reposition of the foot act like a charm, and afford more relief than all antiphlogistics that may be brought to bear upon the diseased structures.

Talipes valgus, dependant on knock-knee, allows an equally favorable prognosis, provided the case is not of too long standing, and the form of the bones not too materially altered.

4. *Talipes calcaneus.*

The term "calcaneus" has been assigned to that rare but very peculiar deformity of the foot in which the os calcis stands on the ground with its posterior extremity, and the foot is extremely

Fig. 13.



bent, the dorsum approximating more or less the tibia, Fig. 13. In the course of our orthopædic

practice we have seen but two indisputable cases of talipes calcaneus. One of them was in a boy about eight years old, whom we accidentally met with on one of the New York ferry boats. His deformity was fully as bad as that we have exhibited in the diagram, copied from Gross' work on surgery. Although he did not consent to have a cast taken of the malposition, which deprives us of the opportunity of showing you an exact copy in plaster, we, nevertheless, took ample time to examine his case thoroughly, and are thus enabled to give you an accurate description. This, together with the above diagram, will afford you a clear idea as to the mechanical character of talipes calcaneus, from which you cannot fail to recognize it.

The case under consideration represented the highest degree of flexion the human foot is capable of. The angle between leg and foot would not have exceeded 12°. The toes occupied almost a vertical position, and the posterior part of the heel rested on the floor, and had become covered with thick callous substance. Although the extremity was decidedly shorter than its fellow, from the arrest of growth, yet the protrusion of the heel served as a substitute for the deficiency. The extensor muscles of the foot (gastrocnemius and soleus muscles) were completely paralyzed, their belly soft and undefined, the Achillis tendon flaccid, while the tibialis anticus and peroneus tertius were intensely contracted, so as to raise even the annular ligament. Any attempt to extend the foot met with insurmountable resistance on the part of the contracted muscles, whereby the toes bent back. The plantar arch was *not materially changed*, and, if at all, it was *diminished*.

Evidently the tibia was riding upon the anterior surface of the trochlea of the astragalus, and its superior surface seemed to be continuous with the posterior surface of the tibia. This anatomical relation accounts readily for the great downward protrusion of the heel. The affected extremity presented in every other respect the *usual symptoms* of talipes.

With reference to talipes calcaneus experience is limited. It is, therefore, doubtful whether the majority of cases be congenital or acquired. In our patient it seemed to be of congenital origin, and obviously caused by paralysis of the triceps and contraction of the two principal flexors of the foot. But, to tell you our honest opinion, if we had not known that there was such a thing as talipes calcaneus, we should have felt inclined to pronounce it posterior dislocation of the foot, so much had it that appearance.

At any rate, it cannot escape your notice that talipes calcaneus is the exact reverse malposition of talipes equinus.

Some authors, as for instance Little, have observed combinations between talipes calcaneus and varus and valgus, which are caused by the prevailing contraction of one of the flexors of the foot over the other. Such complications have received the name of calcaneo-varus and calcaneo-valgus.

The same author relates also a case of calcaneus, produced by an extensive scar in front of the ankle from a burn.

From all we have been able to gather about this subject, the prognosis seems to be rather favorable, provided the case be not of too long duration, and the bones themselves have become malformed. Before leaving the pathology of talipes, we cannot refrain from alluding to a deformity which hitherto has been, and we think very erroneously, considered under the head of talipes calcaneus. From time to time, cases have been presented to our observation that consisted, evidently, in a contraction of the plantar muscles, and, consequently, in an increase of the plantar arch. Sometimes the toes are abnormally flexed or extended. The distorted foot is materially shortened, and, therefore, thicker than the other, the dorsum is proportionately more convex, the heel protrudes somewhat more downward, the ball of the foot is more developed, more especially when the toes are abnormally extended. Otherwise the motor apparatus is in perfect order, and no other muscular contractions manifest themselves.

This species of deformity has consequently nothing in common with talipes calcaneus, in either its pathology, causation, or treatment, and from its frequency deserves a place by itself.

We propose the term of *talipes simplex* or *plantaris* merely to discriminate it from the other forms of talipes.

As to its cause, we are inclined to ascribe it to the wearing of short boots. Among the Chinese women this is at any rate the prevailing cause, and that deformity is therefore very frequent among them. Whether an early inflammatory affection of the tarsal bones or their periosteum gives rise to talipes simplex, we do not venture to determine.

The prognosis of these deformities is governed

by the same considerations we have already mentioned, and we need not repeat them on this occasion.

In fine, we desire to allude to a malposition of the great toe, which gives rise not only to a disfigurement of the foot, but constitutes the source of great inconvenience in locomotion. The toe is mainly outwardly inclined, and forms, with the head of the first metatarsal bone, an obtuse angle. From the metatarso-digital joint all parts recede, leaving a considerable protrusion which is soon covered with callosity, which, being exposed to pressure and friction, inflames and becomes tender. Occasionally abscesses form under the callosity, and thus seriously impede locomotion.

It seems that pressure from too narrow boots is the only cause; but in time, both flexor and extensor become shortened and require division, besides the mechanical appliances. The prognosis is invariably favorable.

Treatment of Talipes.

Gentlemen:—In our discussion on the prognosis of talipes, we have enumerated the chief points of difficulty in the way of its perfect relief. If you have attentively followed us, you must have become aware that the treatment of talipes is by no means as trifling as some surgeons make it appear. The steady advancement of surgical art has greatly facilitated our success; yet we meet with morbid conditions in the deformities of the feet, over which we can exercise but an indirect therapeutical influence. And for that reason, we should enter upon the treatment of those afflictions with correct views of their intricacy. Do not overestimate your ability, neither shrink from difficulties which perseverance and skillful management may overcome. Bear in mind that the division of contracted muscles is but *one of the remedies* we have to employ in the treatment of talipes, and which alone but rarely suffices. The operation of tenotomy most certainly is a great aid, but the after-treatment is equally important. In taking charge of a case of talipes, we should be unremitting in attention, and never leave to unskilled hands the mechanical adjustment of apparatus. In making rational use of all auxiliaries placed at our disposal, we serve both our patient and ourselves, and stand above blame in case of failure. For this appeal to your honor and duty, we have derived a good pretext from our experience. We have observed that poor sufferers, after having been skillfully operated on by eminent surgeons, were turned over to unskilled students for after-treatment. The cases naturally not only failed, but the failure greatly contributed to their aggravation and incurability. There is no reason why students should not enjoy the privilege of witnessing operations of this kind, and benefit by observing the mode of after-treatment. The latter requires, however, a well-trained hand, and we would rather assign the operation to a student than the after-treatment.

The general treatment of talipes resolves itself into the following indications:—

1st. The removal of muscular impediment.

2d. The reposition of the tarsal bones to their normal location.

3d. The re-establishment of the motor power.

4th. The promotion of nutrition, growth, and development of the affected extremity.

In young subjects, muscular contraction constitutes the *chief cause* of most cases of talipes; their division is, therefore, *the chief and sufficient remedy* for the re-establishment of form and position of the foot. All that remains to be done besides tenotomy, is to keep the newly-acquired position by appropriate appliances.

If the bones of the tarsus are malformed, as is usually the case in patients of some age, who have employed their affected extremity in locomotion, the second indication presents itself as the next object of treatment. The means of replacing the tarsal bones are the hand and mechanical appliances. The former is of great service. Without causing any painful pressure or contusion, the great power of the hand can be concentrated at any place where it is needed, and the more assiduously it is employed the more rapidly the bones will yield. *There is no mechanical apparatus, however ingeniously constructed, that could be substituted for the hand in the mechanical treatment of talipes with an approximate degree of efficacy.* In fact, could we without interruption employ the hand as a mechanical agent, we would relieve most obstinate forms of talipes which too frequently withstand mechanical appliances. These latter we resort to as mere auxiliaries, and for the time that the hand cannot be used. Between the two, the mechanical treatment should be divided, and proper care should be taken that the apparatus is always so properly adjusted as to act effectively in the intended direction. In order to accomplish this, the patient should be constantly

under the eye of the attending surgeon, or of a competent substitute, and the propriety of placing a patient in an orthopædic institution suggests itself most forcibly. For, to patients or nurses, such a duty cannot be assigned; they are neither competent, systematic, nor resolute enough.

To a certain extent, the remedies previously suggested comply also with the 3d and 4th indications. It is a common observation of orthopædic surgeons, that the relief of contracted muscles by tenotomy reacts most favorably upon the nutrition of the afflicted extremity, and nutritive supply promotes self-evidently its growth and development. Passive motion co-operates in the same direction. We may, however, do more to promote the motor power still extant, or maintain the fast deteriorating structure of the affected muscles. The most efficacious remedy in behalf of innervation is electricity. It should be used with assiduity every day, and for months in continuation; it will prevent structural decay and stimulate the existing mobility; you can concentrate its action upon single muscles and muscular groups; and, by perseverance, establish muscular action where none existed. Electricity is the substitute of volition, and the best local gymnastic agent. Next are friction with alcoholic liquids; with phosphorated oil, (phosphorus, gr. iij, dissolved in an ounce of warm almond oil;) the use of the flesh-brush, with or without cold irrigation, and such internal remedies as the case may suggest. Proper care should be taken to aid the generation of animal heat in the affected extremity, by advising the use of worsted stockings or flannel bandages. Besides this, a proper hygienic regimen should be observed, to promote the constitutional health.

With all, gentlemen, you may fail in your efforts through the intricacy of the case. All surgeons have had such experience, even in instances that seemed to be promising. Hence, we should advise you never to engage a cure, but simply to guarantee your skill and attention. Your professional dignity and prudence should prevent you from making a promise which you might be unable to realize. For the same reason, do not uncharitably judge the failure of your colleagues, because they may have done their full duty and failed, where you might have been equally unsuccessful.

We propose now to invite your special attention to the subject of tenotomy and myotomy, and render you conversant with the history, technicalities, and indication of that operation. In doing so at this juncture we shall obviate repetition.

Tenotomy and Myotomy.

These comparatively modern operations have, with surprising rapidity, extended the field of their practical utility and have become most indispensable auxiliaries in orthopædic treatment. Like the ophthalmoscope in ophthalmology, subcutaneous tenotomy has revolutionized the orthopædic branch of surgery, and promoted its effectiveness. The operation is trifling when compared with the results. If properly performed, it is scarcely ever followed by inconvenient symptoms, and the small wound it leaves in the integuments usually closes within twelve hours, by first intention.

Although the tendons receive an inferior supply of vessels, which diffuse themselves in the external sheath and internal partition of connective tissue, nevertheless their repair of injuries is most rapid and perfect. The experiments of Paget* upon rabbits are conclusive on this point, and confirm the respective observations of Lebert,† von Ammon,‡ Duval,§ Duparé,‖ and Brodhurst. A great difference is, however, noticeable in the reparative process of tendons, according to the mode of their division. In open wounds there is "more inflammation, and more copious infiltration of the parts than in subcutaneous division in the same rabbit." "Suppuration frequently occurs, either between the retracted ends of the divided tendon, or beneath its distal end." The skin is more apt to become adherent to the tendon, and to hinder and limit its sliding movements. The retracted ends of the tendons are more often displaced, so that their axes do not exactly correspond with each other, or with the reparative bond of union. The consequences of division may, however, be *reversed* by the skillful operation of the one, and a clumsy one of the other. Thus Paget¶ accomplished, in one of his experiments, first intention and speedy repair of a tendon of one leg, after an open division; whereas no repair had commenced on the twelfth day in the same rabbit in the other leg by subcutaneous section. That the delay of repair in subcutaneously divided tendons is not alone caused by the improper execution of

* Lectures on Surgical Pathology. London, 1853, page 176.
† Abhandlungen der Practischen Chirurgie, page 403.
‡ De Physiologia Tenotomiæ.
§ Bulletin de l'Academie Royal de Medecine, 1837.
‖ Nederlandsch. Lancet, 1837.
¶ Ibid., page 119.

the operation, we are satisfied from numerous clinical instances, and we believe that generally impaired nutrition is equally apt to favor suppuration of the divided tendon, and hinder the operative result.

The reparative process following subcutaneous tenotomy develops itself generally in such a manner that, at the instant of division, the fragments separate, "the *upper portion being drawn up* the leg, by the action of the gastrocnemius and soleus muscles," the lower remains opposite the wound. Very little blood is effused in subcutaneous operations, unless large vessels are divided. "Commonly only a few patches of extravasated blood appear in or near the space from which the part of the tendon is retracted." The first apparent consequence of the division of the tendon is the effusion of a fluid or semi-fluid substance, which, like the product of common inflammation, quickly organizes itself into the well-known forms of lymph or exudation cells, speedily becoming nucleated and elongated. The exuded lymph makes the tissues at and near the wound succulent and yellow; the blood-vessels enlarge. Both the exudation and the enlarged blood-vessels distend the parts, so that the skin is scarcely depressed between the separated ends of the tendon. In rabbits forty-eight hours elapse before the *reparative material* becomes apparent. This is deposited in the connective tissue that lies between and close to the ends of the tendons, as well as in the partitions of the tendinous fasciculi of those ends. It thus swells up the space between the separated ends, and makes them larger, somewhat ruddy, soft, and succulent. This apparently fibrous blastema becomes nucleated, and gradually converted into filamentous structure, and at length may become perfect fibro-cellular or fibrous tissue.

As the bond of connection thus acquires toughness and definite character, so the tissue around it loses its infiltrated and vascular appearance, wherewith the integuments become looser, and slide more easily. In the specimens* presented by Tamplin to the Hunterian Museum of the Royal College of Surgeons, England, the new tissue had to all appearance become identical with that of the original tissue.

As to "the strength of the new tissue, and its connection with the original substance by intermingling," Paget furnishes some illustrations. He removed from a rabbit an Achillis tendon that had been six days previously divided and suspended from a section of the same (longitudinal?) gradually increased weight. It bore for awhile ten pounds, and suddenly gave way. In another experiment, the same author employed a tendon that had been severed ten days previously, and he gradually increased the weight to fifty-six, before it parted. We can bear evidence to the great strength of the intermediate tendinous substance, having observed but *one case*, and this in an individual some fifty years of age, in which it gave way in a position comprising both the entire weight of the body, (162 pounds,) and extreme flexion of the foot. Not unlikely, the intermediate substance had remained in a state of fibro-cellular texture.

In the foregoing details of reparation in divided tendons, we have largely drawn from Paget's Surgical Pathology, which gives a most lucid exposé of the entire process. The results of his observations having been derived from experiments with animals, whose muscles were in a state of structural integrity, represent only in a very general way the same process in man. In most instances in which surgery resorts to tenotomy as a curative agency, we have to deal with parts more or less deprived of normal innervation and nutrition. Hence the reparative process is more sluggish, and the transformation of the blastema into proper fibrous structure more or less protracted and imperfect. Yet, with all, the intermediate substance becomes, in the course of time, so strong and tenacious as to subserve the intended purpose. Then, again, the divided muscles and tendons have suffered more or less structural changes, which prevent them from retracting to the same extent as healthy muscles. This fact is worthy of note.

Another circumstance we have to mention as immediately connected with tenotomy, is the subsequent relaxing of the muscular belly a day or two after the section of its tendon, and the consequent approximation of its two fragments. Dieffenbach, we believe, was the first who called attention to this fact, and from that he inferred the antispastic effect of tenotomy. The explanation of the phenomenon is, that after section of the tendon the muscle contracts to the utmost of its capacity, and the excessive contraction subsequently relaxes by being tired out. We have observed analogous facts in the fracture of the patella, the olecranon, etc.

* Nos. 358, 359, 360.

History of Tenotomy and Myotomy.

The first attempt at tenotomy is to be traced to Thilenius, who, in the year 1784, divided the Achillis tendon, after having made a free incision through the integuments. The patient, a girl of seventeen years, recovered, and the operation proved successful. The next operation of this kind was performed by Sartorius, on the 16th of May, 1806, upon the son of Martin Oust. The proceeding commenced with an incision four inches in length through the skin over the tendon; the cicatrices around the joint were carefully dissected off, the tendon transversely divided, and the foot broken straight by main force, whereby a crackling noise was heard. Michælis, on the 16th of November, 1809, in a case of club-foot, proceeded in a similar manner, with this difference, however, that he only *incised* the tendo-Achillis, rupturing the remaining portion.

The fourth operation of tenotomy was executed by Delpech,* on the 9th of May, 1816. His case was talipes equinus, in an infant two years old. With that sagacity which characterizes the entire surgical career of this truly great surgeon, he recognized the practical advantages of a *smaller* opening through the integuments and *remote* from the tendon, and virtually performed thus the first *subcutaneous* division.

Delpech† prescribed the following axioms in the performance of tenotomy:—

1st. The tendon to be divided should not be exposed; its section should be made by entering the knife at a distance from the tendon, and not through an incision of the skin parallel to it. There is danger of exfoliation of the tendon, unless this precaution be taken.

2d. Immediately after division of the tendon, the divided extremities should be brought in contact, and so held by a suitable apparatus until reunion is accomplished.

3d. As reunion can only take place by an intermediate fibrous substance, gradual and careful extension should be made to give the required length to the shortened muscles before solidification takes place.

4th. Extension being complete, the limb should be fixed in this position, and there kept until the new substance has acquired that firmness of which it is susceptible.

Although the result in Delpech's case was quite satisfactory, the patient having acquired the proper form and position of the foot, and being enabled to use it in locomotion with firmness and rapidity, it seems that it was the only tenotomy that surgeon ever performed.

Of Dupuytren it was said, that he adopted the plan of Delpech in several cases; but when, and with what benefit to the patient, we have not been successful in finding out.

For about fifteen years the operation of tenotomy was not repeated, when Stromeyer not only resuscitated, but established it at the same time on a secure and permanent basis. His first tenotomy‡ was upon George Eblers, a young man of nineteen years, resident of the City of Hanover, and was performed on the 28th of February, 1831.

The discovery of Stromeyer, that tendons and muscles might be subcutaneously divided with impunity, opened at once a wide field for orthopædic exploits. The prominent surgeons of Germany eagerly took hold of the new operation. The observations of Stromeyer were at once and everywhere put to a practical test. Very soon the medical periodicals abounded in praise of the new orthopædic measure, which was unanimously pronounced to be both harmless and efficacious. All cripples in the land were hunted up and invited to obtain relief by the new proceeding. Dieffenbach alone, if we mistake not, performed more than two hundred operations in the course of one year, and other surgeons large numbers in proportion to their popularity and public trust. From the various scientific centers in Germany, tenotomy radiated with unexampled rapidity to the remotest corners of the civilized world. Enthusiasm ran into a tenotomic fever, which took the character of an epidemic. Experience has established the true basis upon which the operation rests. It has decided the applicability of tenotomy and the non-applicability. It has put in a proper light both its merits and abuses. Since its advantages and demerits have been duly established, it has been recognized and incorporated in scientific surgery.

Technical Rules of Tenotomy.

For the object of the operation it is indifferent from which side a tendon is divided, whether from within or without, provided a small wound be made and proper care be taken to exclude air. Most surgeons prefer, however, to enter the knife

* Chirurgie Clinique de Montpellier, tome i., 1823.
† De l'Orthomorphie, tome ii., 1828.

‡ Rust's Magazin. Band xxxix. p. 193. 1833.

behind the tendon and divide it toward the surface of the body. Some tendons are placed in such close proximity to nerves and vessels that the other way suggests itself as preferable, on account of the lesser danger of injury. Thus, for instance, in dividing the external hamstring we can more readily avoid the peroneal nerve, and consequently paralysis of the peronei muscles, by approaching the tendon externally.

The next technical rule is the appropriate position of the patient. The parts to be operated on should be well exposed to light, well accessible to the hand of the operator, and allow all the changes that may be demanded by the operation.

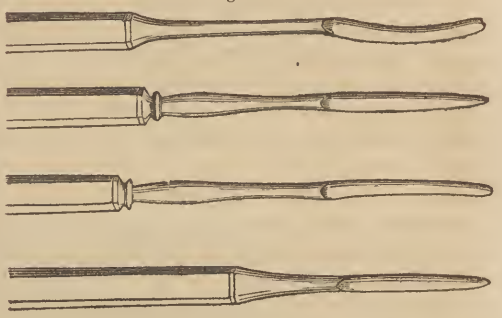
Further, the extremity requires to be immovably fixed by reliable assistants in a directly *reverse* position to the existing deformity. This precaution is indispensably necessary: *a*. To render the tendon (or muscle) more defined, recognizable, and accessible. *b*. To raise the tendon (or muscle) off from the adjacent parts, and to render it more divisible. In fine, *c*, to protect the wound against the entrance of air.

These rules are to be so modified as to leave the extremity in the same position, until the tenotome is introduced and has arrived opposite the tendon, if it should be intended to divide the latter from without, otherwise the tension must be kept up until the operation is finished. The extremity is then reduced to its original malposition. The wound must be carefully closed and covered with a piece of adhesive plaster, and the parts kept at rest. We use for the latter purpose a leather splint previously softened in warm water, which we fasten with an ordinary roller. In this state the extremity may be left for three or four days before the after-treatment is commenced. This plan has the advantage of insuring a perfect closure of the wound, and there is no danger of air entering when the parts are subsequently handled. Nor is this apparent delay a real loss of time, inasmuch as the reparative process does not usually commence before the fifth day. If, at the end of that time, the wound be found properly closed, we place the patient once more under the influence of chloroform, and by main force reduce the malposition as far as it can be safely done. In breaking up some adhesions or in tearing some ligaments we risk nothing, since the anæsthesia seems to protect against reactive consequences.

The requirements for the operation are three or four small, narrow-bladed knives, sponges, water, adhesive plaster, a piece of harness leather, and a roller.

The knives have been differently constructed. Some surgeons prefer the sickle-formed, others the straight blades. We use chiefly the latter. A strongly bent sickle-formed blade is certainly not desirable, and a too long and pointed blade is apt to perforate the skin on the opposite side from whence introduced. The tenotomes which we have adopted, and which we now exhibit, have square handles three and three-quarter inches in length, and about as large in size as an ordinary penholder. The knives are of the best English cast-steel, well tempered, narrow but substantial. The neck is one inch and the blade one and one-eighth in length. Some of the tenotomes should be finely pointed; the others may be blunt. We have in our set straight and convex ones, Fig. 14. The last we use for the

Fig. 14.



division of tendons or muscles from without. Blunt-pointed tenotomes we use for special purposes, in order to ferret out more safely deeper-seated tendons or muscles.

Having the extremity placed as directed, and under the control of an assistant, take the tenotome like a pen and insert rectangularly the point through the skin about a line or so from the margin of the tendon or muscle, the surface of the blade being parallel with their longitudinal axis, until you arrive to the depth of the posterior surface of the same. You then recline the handle and push the knife behind the tendon or muscle until you feel the point on the opposite side through the integuments. The knife is then so rotated as to turn its cutting edge toward the structure to be divided, and by short, sawing cuts, but more by pressure, it is to be thus severed. In the moment that the last fibers yield to the knife, the resistance ceases, and with it the peculiar sound that attends it, or, at any rate, that

which is heard in the division of a tendon. Having become satisfied that the operation is complete, the knife is to be withdrawn in the same manner as introduced. Otherwise, it is turned against the remaining undivided fasicles and pressed through. For novices, it might be advisable to make the punctured wound through the skin first, and then to use a blunt-pointed knife for the division, which obviates the splitting of the structures. The index finger of the left hand of the operator should then sweep along the subcutaneous wound, with a view to squeeze out air and blood, and to compress the two edges until covered.

The operation thus described necessitates some modifications in certain places, which we shall mention when we speak of the special application, and exemplify them by the operations upon subjects.

The Mechanical Treatment of Talipes.—We have already stated that the hand is by far the best, the most powerful and direct mechanical agent. No mechanical appliance bears comparison with it in efficacy. The more freely it is used in reference to the former, the better is the result and the less inconvenience is caused to the patient. The first handlings of the distorted foot should be made with the assistance of anæsthetics. That spares the patient pain, allows the employment of more force, and protects against reaction. After you have the patient thus prepared, you take firm hold of the leg with one hand and the foot with the other, and by main force you correct the position by bending the foot into the reverse one from that into which it was drawn by the contracted muscles. If you intend to diminish the longitudinal plantar arch, you hold the heel with one and the forefoot with the other hand, and while you thus extend the arch you press with the two thumbs the protruding bones down. In a similar manner you may proceed in reducing the transversal arch, with only this difference, that you press upon the most convex part of the external margin of the foot. These are the general rules for handling talipes, and may be repeated as long as the anæsthesia lasts, or as may be deemed safe and practicable. After a violent proceeding of this kind it may be advisable to allow the member some rest, and to apply cold fomentation for a day or so in order to obviate inflammation; although we have seldom had occasion to resort to them. At a later period, and when the malposition of the bones shows some disposition to yield to the treatment, milder exercises may be made daily once or twice without chloroform, until the malposition is overcome, and every joint moves with ease and normality.

Mechanical Appliances in Talipes.—Much constructive genius has been employed by both surgeons and instrument makers to create mechanical means, combining traction and pressure, with a view of reducing both malposition and distortion of talipes. At a time when the proximate cause of talipes was obscure, and the bones of the foot were supposed to be originally malformed, pressure was diligently applied, and mechanical appliances were of the utmost importance. Almost every surgeon had his own designs, and if we had to reproduce them on this occasion, the various instruments of this kind would fill a large space of this lecture-room. But surgery, and, with it, surgical operations and mechanical remedies, have become more simplified. And in orthopædy, tenotomy has greatly tended toward that end. Nevertheless, we are still in need of mechanical means to reduce talipes, yet with this qualification, that they are no more the chief but merely subordinate and auxiliary remedies, and intended to perpetuate the action of the hand. *They possess no positive curative virtues, but retain the foot in the position in which tenotomy and the acting hand left it.* Their effect is greatly enhanced by the weight of the body and the motion of the joints.

Whatever the construction of those mechanical appliances may be to which we resort in the treatment of talipes, they should possess the following qualities:—

1. They should fit well, and most *accurately* conform to the shape of the member.

2. Their respective joints should be exactly located with the *axis of the motion* of the joints they are to subserve.

3. Their action should be diametrically opposite the traction of the divided muscles, tending to a reverse form and position.

4. Their action should be steady, and, while applied, uninterrupted.

5. They should keep the foot firmly upon the sole of the shoe, and should not permit the heel to rise from its place.

A mechanical apparatus with these qualities will fulfill its object, whatever its construction may be.

Special Treatment of Talipes.

(1) *Talipes Equinus.*—In the pathology of this deformity we have stated that its proximate cause may consist:—

1st. In a paralysis of the flexor muscles and a mere preponderance of the extensors.

2d. In an active contraction of either the triceps alone, or of the entire group of extensors.

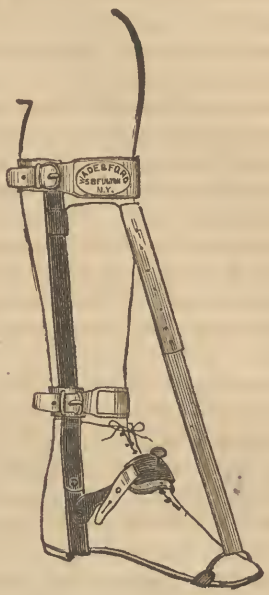
In the former condition, we are able to flex the foot by substituting the hand. These cases are comparatively rare, and if they have commenced as a paralysis of the flexors, they most generally, and in course of time, terminate in active contractions of the extensors, and become therefore identified with the active forms of equinus. In both conditions, however, the growth of the entire extremity is arrested and its length materially diminished.

Before attempting to remedy the deformity, we have to consider the present locomotion of the patient and the changes that would inevitably be produced by the correction of the deformity.

If the deformity be just enough to add to the lost length of the extremity, and renders locomotion perfect, we have no feasible pretext to interfere, in any way, with the trouble—for the deformity is, certainly, the lesser evil, and the usefulness of the limb the higher consideration. On this very ground we have refused to treat such cases. In recent cases, however, we may undertake the treatment with a view to promote the growth of the extremity, and to accomplish, likewise, a perfect cure of the deformity.

If, therefore, a case of equinus is presented with a paralysis of the flexors, we should at once enter upon the treatment of the paralysis according to the general rules we have previously suggested. Next, we should provide the foot with an apparatus, in which the action of the flexor muscles is substituted by elastic bands, sufficiently strong to balance the extensors. Such an apparatus you see before you, Fig. 15. It consists in a strong shoe, with an iron sole. From the latter, braces arise on either side of the leg, and extend to the knee-joint. At the ankle there are joints which should easily move, and exactly correspond with the axis of motion of the articulation. These braces have two bands, one below the knee-joint, and one above the ankle, to fasten around the leg. At the anterior part of the sole an iron arch should be movably fastened over the foot, and a similar one at the upper portion of the brace. Between the two a piece of India-rubber should be so fastened as to flex the foot. This apparatus will suffice for a mild case. But when the resistance of the extensor muscles is considerable, the heel will leave its place, and

Fig. 15.



thereby defeat the object. In order to prevent this, a leather strap was formerly employed across the instep to keep the heel down. This is a very improper arrangement; for it is inefficient, and interferes with the circulation to such an extent as to become unbearable. In order to obviate the latter inconvenience, and render the action effective, we have constructed a double screw on the principle of the tourniquet, Fig. 16, which we fasten by leather straps to horizontal side pieces affixed to the brace below the ankle-joint. We look upon this contrivance as exceedingly useful, and almost indispensable in most

Fig. 16.

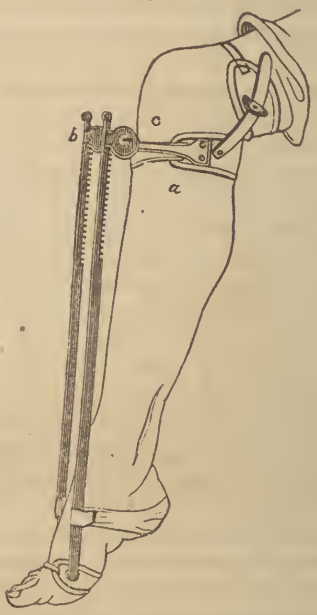
forms of talipes, because it does away with the rising of the heel, with the interference in the circulation, and may be profitably employed for permanent pressure upon the dorsum of the foot with a view of diminishing the plantar arch. The lower plate of this contrivance should be well padded, and the pressure to be exercised should

be regulated so as not to become excessive. If the skin becomes red by the pressure, it should be shifted to another place to obviate excoriation. This apparatus is, in our humble opinion, the best that has been hitherto constructed. The specimen before you has been made by Messrs. Wade and Ford, Fulton St., N. Y., who are certainly very proficient and commendable makers of orthopædic apparatus.

In the active form of talipes equinus, in which you have to deal with active contractions of the extensor muscles, the treatment is to be initiated by tenotomy. The operation is the more effective the earlier it is performed. We have had cases under our charge which have been so completely relieved by the section of the Achillis tendon that, after years, not the slightest trace of the previous deformity could be perceived, the limb having grown as its fellow. If the triceps be alone contracted, the Achillis tendon should be divided at a place from three-fourths of an inch to one inch and a quarter above its insertion—the exact place in accordance with the length of the tendon.

If all the flexors be contracted, the entire group should be divided at the same time. It will be recollected that the tibialis posticus muscle is located immediately behind the internal angle and the malleolus of the tibia; that its tendon at the malleolus lies in a groove, surrounded by a sheath, and covered in by the aponeurosis of the leg. On account of this anatomical relation, it is somewhat difficult to get the tendon upon the knife. In order to divide it successfully, we proceed as follows: About an inch or a little more above the internal malleolus, we insert a sharp-pointed tenotome through the skin and aponeurosis close to the internal angle of the tibia, and by inclining the handle we enlarge the opening through the aponeurosis. After having withdrawn the knife, we introduce into the wound a blunt-pointed tenotome. We keep it near the bone, and push it between the tendon and the latter. During this part of the operation, the foot is to be left in its original malposition. Having become convinced that the knife has arrived at a proper depth and the tendon successfully placed upon it, we direct our assistant to flex and abduct the foot, and while this is done the cutting edge of the knife is turned toward the tendon and the latter divided. The grating, its sudden cessation, and the yielding of the foot toward abduction are the evidences of a successful division. Otherwise we have to make the operation complete by renewed attempts at catching the rest of the tendon. The posterior tibial artery lies very rarely near the place which we have chosen for the operation, and there is therefore no great danger of wounding this vessel. Graduated compression against the tibia will meet the exigency if the artery be cut.

Fig. 17.

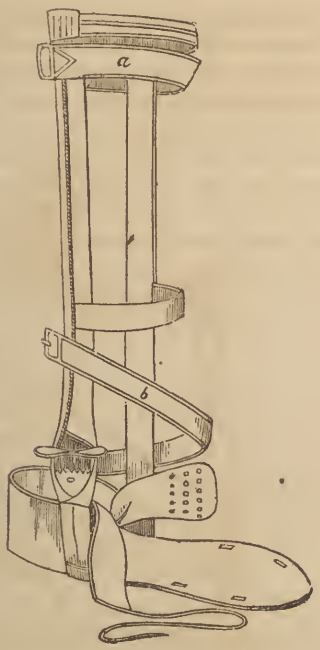


The anatomical location of the two posterior peronei muscles alongside of and behind the fibula, is somewhat similar to that of the posterior tibialis, but their tendons are much more accessible, and therefore more easily to be divided. In reference to the after-treatment, we have little to add. The instrument just described will suffice. The diagrams on exhibition are the apparatus used by Delpech, Fig. 17, and Scutetten, Fig. 18.

The complications of talipes equinus which occasionally present themselves are, contractions of the extensor longus pollicis, tibialis anticus, and peroneus tertius. The first is the more usual complication, mostly requiring the division of the corresponding tendon. The most accessible places for reaching the tendon for the operation are in front of the ankle-joint, where the tendon lies between the tibialis anticus and the long extensor of the toes, and next behind the capitulum of

the first metatarsal bone. No peculiar difficulties attending the operation at either place, we refer to the general directions on tenotomy.

Fig. 18.



If the tibialis anticus be contracted, the foot is more or less inverted thereby, and the deformity is thus produced which is known by the appellation equino-varus. In such a case, the tibialis anticus is likewise to be divided. The tendon of this muscle descends nearest to the internal malleolus, and can be rendered tense by eversion of the foot. The operation itself is performed immediately below the ankle-joint, and requires no special direction.

The most satisfactory results have been accomplished by us, in first dividing the tibialis muscle and reducing the distortion to the simple form of equinus. We affix to the outside of the leg and foot a straight and well-padded splint, by means of which we draw the foot over to the outer side. In this position we keep it until it has lost all disposition to inversion, and then we proceed with the division of the extensor muscles. During the after-treatment of equino-varus, Scarpa's shoe, as improved by Stromeyer, Fig. 19, should be worn by the patient, and in these lighter cases it will be found beneficial. This apparatus may be greatly improved by combining it with the elastic straps and our double screw for the dorsum of the foot. The latter is the more indispensable if the plantar arch be found abnormally increased.

Fig. 19.

The contraction of the peroneus tertius will evert the foot and present thereby the complicated form of equino-valgus with more or less the attributes of flat-foot. Inasmuch as we have to devote our attention more especially to this subject hereafter, we beg leave to reserve our opinion at this place, only remarking that the modification in the treatment can be readily inferred.

In fine, if a case of simple equinus be disqualified for operation for reasons already assigned, and should need an apparatus for concealment, it may be well to acquaint you with our device. We procure a wedge-shaped piece of cork of sufficient thickness behind to fill the distance between the heel and the floor; over this we have the measure of the foot taken and a boot made that has to receive the cork inside, or it may be worked in as a part of the sole. This furnishes a boot which is not so unsightly as the deformity, and with which the patient is enabled to walk with ease and facility.

2. *Talipes varus.*

In this deformity we have to grapple with—

1st. Contractions of the triceps muscles;

2d. Contractions of one or both tibialis muscles;

3d. Contractions of the plantar muscles; and, occasionally,

4th. Contractions of either flexors or extensors of the toes.

Before entering upon the treatment of varus, we will first discuss the important question as to the proper time to commence it. Inasmuch as by far the larger proportion of varus is of congenital nature, it is consequently noticed immediately after birth. It will be well to test at once the pathological character of the deformity. If the latter should prove to be simple malposition of the foot, and simply caused by the previous position in utero, it will be well to reduce it forthwith, and to keep it adjusted in a proper position for some days. Leather, or gutta-percha splints, as Post uses, are to be so moulded to the extremity as to embrace both sides of the leg and foot.

If, however, the cause of club-foot be found to consist in muscular contractions, the application of splints would be futile. Tenotomy alone can give relief. The proper time to perform that operation is at the end of the first year, when the principal part of teething has passed, and the patient evinces some disposition to stand and walk. Locomotion and standing upon the deformed foot being both favorable to the malformation of the tarsal bones, and therefore highly prejudicial, should not be permitted under any circumstance.

In proceeding with the operation, the general state of health of the child should be good, otherwise the wound might suppurate and thereby peril the final result. The operative treatment of varus should be divided into two parts. At first, the contracted tibialis muscles should be divided, and thereby the varus reduced to equinus, in the manner already indicated. This treatment should be persisted in until the tendency of the foot to inversion is, in great part, overcome. This is still more necessary in varus than in equino-varus, and the result is always satisfactory if this part of the treatment has been extended over a sufficiently long period. Secondly, the Achillis tendon and the plantar fascia with its contracted muscles should be simultaneously divided, because the flexion of the foot and the extension of the plantar arch may be combined by the same mechanical agents. Whether the tendons of the contracted toes may be likewise divided at that or at any later time, is of little consequence. Most usually an undue flexion of the toes is relieved by the plantar section.

Having thus accomplished the relief of the entire contractions, the manipulations and mechanical treatment fairly commence. We exhibit in this diagram the clumsy apparatus used by Stromeyer, Fig. 20, which is still employed by some surgeons. We cannot advocate its application (although it has pretty nearly all the actions of a good apparatus) for the reason that it is too heavy, that it allows of no fine regulations, and that it obliges the patient to remain at rest. In infants that are to be carried about, it is absolutely impracticable. Stromeyer's improvement of Scarpa's shoe is likewise inefficient. The second boot of Scarpa, Fig. 21, in which the front part of the sole can be turned and regulated by a screw, is somewhat better, yet its action does not comply with all the indications in the mechanical treatment of varus. In using the latter apparatus the whole leg is turned; but the malformation of the foot is scarcely influenced. In fact, among all the existing apparatus for club-foot, there is none that combines all the mechanical actions required. Doctor Ross', of Altona, is comparatively the best, and its construction clearly indicates that the inventor has penetrated the mechanical difficulties in varus, yet it is still imperfect, and deprives the patient of locomotion.

Fig. 20.

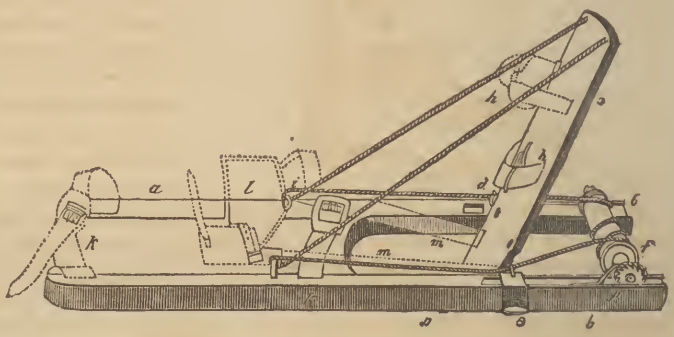
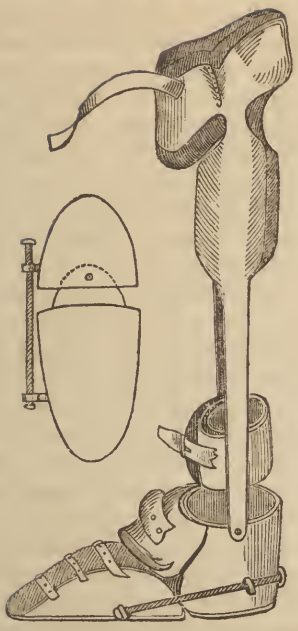


Fig. 21.



Although we have never attached the same importance to mechanical means as some surgeons have done, and substituted the hand when ever practicable; yet if, from necessity, we have to resort to their use, it is obviously desirable to procure the most effective construction. Practically convinced of the imperfections of most apparatus heretofore employed in the mechanical treatment of club-foot, we have, for years, persevered in improvements, until we succeeded in constructing an apparatus which, we feel persuaded, answers all the detailed indications.

We wish, however, to be distinctly understood that we lay no claim to originality; for we have made liberal use of the pre-existing apparatus, and more especially we have adopted the pad-construction of Ross. Our merits, if there are any in the premises, resolve themselves into the practicable combination of the single advantages of others in a small compass, in which the details are most direct and effective, while the whole apparatus is no incumbrance for locomotion. In exhibiting the same, Figs. 22, 23, we will explain its construction, and render you familiar with its use.

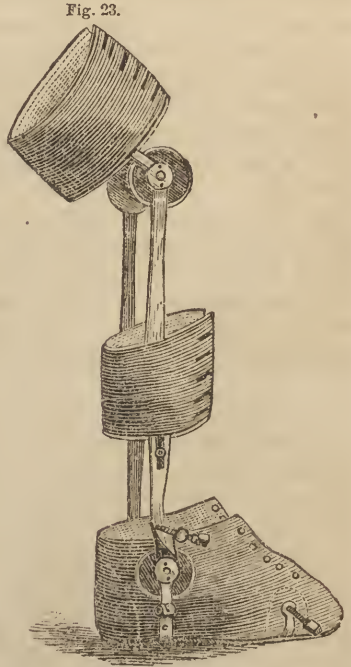
The chief feature of our apparatus lies in the construction of the part designed for the foot, and the greatest attention should be paid to its proper fit.

For this purpose we take a moderately short piece of pasteboard, place it under the sole of the club-foot, and draw its contours by a pencil, allowing, however, some space for padding and changes in width and length of the foot, to be gained by the treatment. Next we should mark the places which correspond with the ball of the large toe, and the most prominent protrusion of the external margin of the foot, where pads are to be put in action.

According to that pattern, the sole of the apparatus is made of stout sheet-iron, covered inside with buckskin or stout felt, and outside with moderately thick sole leather, both fastened through the iron by copper rivets. The heel-band is arranged as in Scarpa-Stromeyer's shoe —but should have two brass buttons to fasten the double screw. At the two marked places of the sole, rectangular pieces of iron are riveted to the sole, and through the upright portion a screw passes with a well-bolstered pad at its in-

Fig. 22.

Fig. 23.



ternal end. If the foot be placed in this apparatus, we have four points of direct action. First, the double screw on the dorsum of the foot, to reduce the plantar arch. Second, the heel-band and the toe pad at one side, and the tarsal pad on the other, to reduce the horizontal infraction of the foot. By means of a key, the pad screws may be regulated, and the pressure increased and decreased at will. This arrangement keeps the foot in its place, while the most effective and steady pressure is kept up. The pressure upon the opposite and most projecting points of the foot must not be too severe, otherwise it will cause inflammation and slough of the skin, which would arrest the progress of the treatment, since the pads cannot be shifted from one place to the other. Besides a good bolstering of the pads, we have found it very protective to cover the places to be pressed in by a piece of adhesive plaster.

The entire foot-piece is joined by the iron stirrup to the leg-brace, as in the apparatus for equinus. The elastic strap which we recommended in that, to flex the foot, may be also employed in this apparatus, but it, alone, is rarely sufficient, therefore screws are to be employed at the ankle-joint to bend the foot. In fine, the leg-brace should be extended to the knee-joint and there connected with a brace for the thigh, for the purpose of controlling the actions of the knee.

If it should be found that the whole extremity inverts at the hip-joint, which is rarely the case, the apparatus should extend up to the joint and connect with a belt around the pelvis, with a view of turning the extremity in the opposite direction.

In this construction we lose the rotation of the foot as effected by Scarpa-Stromeyer's shoe, but it is impossible to combine this action with the others and likewise attain a substantial and steadily-acting apparatus. The rotatory movements must therefore be made by the hand.

3. *Talipes valgus.*

In valgus we have either complete paralysis of the entire muscles of the foot, which yields to the weight of the body, or the abductors are shortened. In the former instance the treatment is to be directed toward the paralysis according to the maxims laid down. The mechanical apparatus to be applied has to fulfill two objects—1st. To support the tibio-tarsal articulation in order to sustain the weight of the body. 2d. To raise the plantar arch. For the first indication, various suggestions have been made. A high, well-fitting, laced boot, rendered more capable of giving support by whalebone or stout leather strips vertically adjusted, is recommended; also a dextrine or plaster of Paris bandage ascending from the foot to the middle of the leg. These are very efficient supports for the time being, but are clumsy, require frequent application, and exercise a certain pressure upon the extremity, and thus are liable to increase the attenuation. We have therefore applied a brace like that in equinus, with this modification: we fasten a large and good pad inside of the ankle-joint, toward which the joint may incline without pressure. To the brace may be attached in a similar manner elastic straps, to serve as a substitute for the lost muscular action. If the extremity be shorter than its fellow, the sole and heel of the boot should be made as high as is necessary to correspond with the length of the other.

In order to raise and support the plantar arch, we advise that a little cushion, made of buckskin and in the shape of the arch, be established inside of the boot. The best plan is to commence with one or two layers of the skin and increase the thickness as the treatment proceeds.

The active forms of valgus necessitate the division of the contracted peroneus muscle, or of the whole group of the abductors, as the case may be. This is at least indispensable in inflammation of the tibio-tarsal articulation, and should be followed up by circular pressure with adhesive strips and leather splints in front, to steady the joint and secure rest. It is almost incredible how beneficially this proceeding acts upon the affection, and it does away with all the eccentric and useless suggestions of derivation, moxa, and the actual cautery. In this simple manner we have successfully treated numerous cases of this kind, which had been the source of intense suffering for years, being naturally aggravated by each attempt at walking.

If the contraction of the peronei muscles be connected with paralysis of the tibiales muscles, the expediency of dividing the former may be disputed on the ground that injury is being added to the already existing difficulty. The question, however, remains, how shall we mend the deformity and enable the patient to employ the member? It is already difficult to steady the articulation with mechanical appliances in paralysis of the entire motor apparatus of the foot, but it is completely impossible to do so when the malpo-

sition of the latter is maintained by retraction of the peronei muscles. We, at least, have never succeeded by any of the devised mechanical auxiliaries. Meanwhile the deformity increases and gradually compromises the bones of the tarsus. Between the two evils we have to choose, and we think that the division of the contracted muscles is the lesser. Certainly we paralyze the divided muscles for a time, but we have the chance to invigorate them again by galvanism. Moreover, we arrest the progress of the deformity, and protect the tarsal bones from becoming involved. Above all, we qualify the patient for locomotion. For these considerations we advise tenotomy as the best symptomatic remedy, and depend on time and other means to accomplish the rest.

4. *Talipes calcaneus.*

The therapeutic suggestions for the management of calcaneus we have chiefly derived from other authors, since we have had no case under our charge. Little, Brodhurst, and others coincide in the necessity of dividing the tibialis and peroneus tertius, and, if necessary, the two remaining flexors of the foot, extensor pollicis longus and digitorum communis longus. The foot should then be forcibly extended and kept in extension by splints; meanwhile, frequent passive motions should be made in the ankle-joint, and the after-treatment followed up with the boot used in equinus, with this difference, that the elastic band should be fastened to the heel and the leg-band, to act in the place of the paralyzed triceps suræ. If the elastic band should suffice to keep the foot rectangularly to the leg, the section of the flexor should of course be dispensed with.

5. *Talipes plantarus*

Requires, for its alleviation, the section of the contracted plantar muscles, including the plantar aponeurosis, an iron boot, with vertical pressure upon the dorsum of the foot by our double screw. This plan will stretch the foot and diminish the plantar arch. With this treatment we have even succeeded in a case of eighteen years standing.

6. *Abduction of the large toe*

Necessitates the division of both the tendons of flexors and extensors, and a triangular cushion between the first and second toe; in very obstinate cases, an iron-soled shoe, with pad pressure upon the protruding articulation, should be resorted to.

7. *Burns in the neighborhood of the ankle-joint*

May have caused contraction of the skin and malposition of the foot. In such a case, gradual and persistent extension in the opposite direction will most usually overcome the contraction; and, according to the case, one of the orthopædic apparatus which we have suggested for the treatment of the various kinds of talipes may be employed. The subcutaneous loosening or plastic operations are rarely required.

Since the delivery of the lectures on talipes, we have become acquainted with the peculiar views held by Prof. Pancoast, of Philadelphia, and have had personal opportunity of witnessing their practical application. Although not as yet prepared to offer an opinion as to their correctness, they certainly command our highest consideration. That distinguished surgeon is of the opinion that in talipes equinus and equino-varus, not the entire triceps is contracted, but the soleus muscle exclusively. He therefore contents himself by cutting off the insertion of that muscle from the lower and anterior portion of the gastrocnemius and the upper part of the Achillis tendon, and assured us that for the last ten years he had not divided the tendon itself. On a recent visit to Philadelphia, Prof. Pancoast had the goodness to perform the operation upon two patients for our especial benefit, and gave us the opportunity of assisting him in both cases. We were thus enabled to examine the patients before the operation, with and without anæsthetics, and also to observe the immediate effects of the division. Both cases belonged to the incipient forms of equino-varus, and were congenital. One patient was one year, and the other three years old. When we forcibly flexed the foot, we expected to render the entire triceps tense. This was, however, not the case. The belly of the gastrocnemius remained flacid, whereas the soleus was evidently hard, tense, and resisting. This condition suffered no alteration under anæsthesia. During the operation we distinctly perceived the yielding of the malposition, and as soon as the last fibers had been divided, the foot could be flexed without great effort.

The operation was performed in a masterly manner, as follows: The limb being placed on its outer aspect and kept limber, the operator

grasped the belly of the gastrocnemius and raise it off from the soleus. He then introduced a sharp-pointed tenotome through the skin and aponeurosis. In the wound was inserted Bouvier's blunt-pointed, convex tenotome, so deeply as to be felt on the other side between the gastrocnemius and soleus muscles. At this moment the soleus was rendered tense by strong flexion of the foot, and with a horizontal section, the insertion of the soleus was carefully divided. The foot was at once secured in a simple but efficacious apparatus, in which flexion was effected by a screw traversing the ankle-joint of the brace.

We were forcibly struck with the ingeniousness of the operation, but must withhold our opinion as to its general applicability. That in the above cases, the soleus was exclusively implicated in the malposition, no reasonable doubt could be entertained. We are not prepared, however, to admit or deny the opinion of Dr. Pancoast in the generality of cases, until further experience shall give us an opportunity of thoroughly testing it.

II.—*Deformities at the Knee-joint.*

Gentlemen:—The articulation to which we now invite your attention is very important. Its anatomical construction is complicated. It participates in almost all active positions the body may assume, bearing at the same time the superincumbent weight. It is but indifferently protected by soft tissues, and much exposed to traumatic injuries. The latter are the remote cause of by far the larger proportion of deformities occurring at the articulation. The form of distortion resulting from that source is simple flexion of the leg, Fig. 24, with more or less rotation of the tibia and eversion of the toes. Contraction of the biceps muscle is so constant a symptom of inflammations of and about the knee-joint that it may be set down as pathognomonic.

We need not repeat on this occasion all we have adduced in our general remarks on reflex actions, as co-ordinate symptoms in articular diseases; nevertheless, we desire to re-engage your interest on some very prominent points.

In all articular diseases, and more especially in those of the knee-joint, contractions of the flexor muscles of the leg form a prominent feature. They mostly appear soon after the commencement of the disease; but certainly they scarcely ever fail to set in during its progress. Inflammatory affections of the knee-joint, without reflex symptoms of this order, are very rare, and are, therefore, extreme exceptions.

Fig. 24.

The form in which these reflex symptoms appear is that of a tonic spasm; but, exceptionally, we have observed them to be of the clonic form. In the case of Ludwig Schindler, alluded to in our clinical lectures "on Contractions of the Knee-joint," they assumed the character of local convulsions, which kept the affected extremity, with few and short intermissions, in a most painful quiver. But even in tonic spasms, you may notice these convulsive oscillations in the contracted muscles whenever you disturb their status. And it is rather surprising that this prominent symptom of reflex action should have been, at so late a period, noticed, and received its proper physiological commentary; more especially as it is combined with a peculiar pain which has no direct connection with the progress or regress of the original disease in the joint. We are satisfied that the intensity of reflex symptoms acts more directly and more prejudicially on the constitution of the patient than the latter, and therefore it is of the greatest practical importance to prevent them, or to simplify the disease by their removal.

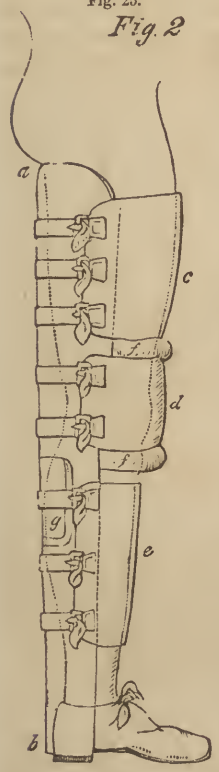
Whenever you are called to a case of injury to the knee-joint, however trifling, it will be worth your while to pay due attention to this symptom; and if you find the slightest tendency to flexion, the attempted extension of the leg being painful, you had better at once employ extension and counteract the mischief at the very commencement. It would justly reflect upon the skill and knowledge of a surgeon, if he should allow the severe sufferings of his patient and the most unsightly deformity to grow under his eye, without

resorting to remedies which are known to be efficacious.

If, however, the contraction of the hamstring muscles have become permanent, extension alone is rather hazardous, for it may give a new impetus to the active disease. Nay, more, we have seen the disease reproduced after a lapse of years, by indiscreetly employing undue extension. In these cases, the division of the contracted muscles, or their tendons, should precede the use of extension; and this alone will do more for the arrest of the disease than the balance of antiphlogistic or constitutional remedies.

Fig. 25.

Fig. 2



Although it is not our province to enter upon the consideration of articular diseases, yet we cannot refrain from remarking that their treatment renders the employment of orthopædic measures imperative; not so much for the purpose of relieving the deformity, as to remove an element of the disease itself, which it is dangerous to disregard. Our success in the treatment of incipient and advanced joint diseases, we can ascribe to nothing else than to a due attention to this momentous symptom. Lately we employed a straight iron splint, Fig. 25, surrounding three-fourths of the extremity from behind, and extending from the tuber ischiæ down to the heel. In this, well padded, we bandaged the limb down in a straight position, and thus secured both rest and extension. But we feel persuaded that a simple cord and pulley and a proportionate weight is the gentler, and certainly the more reliable remedy.

The mode of applying them is simply as follows: Take a sufficiently long and wide strip of adhesive plaster—the better is that of Canton flannel because the stronger—and fasten it with a roller on either side of the leg, beginning about an inch below the joint and leaving a loop below the foot. Place a simple pulley at the foot of the bed; lay the leg of the patient upon a water-cushion, and fasten a string to the loop in the plaster, carrying it over the pulley, and attach the weight at the end. The body of the patient is mostly a sufficient counter-weight. If deemed necessary, apply counter-extension to the pelvis. It may also be advisable to protect the instep of the foot and the Achillis tendon from the pressure of the bandage by a small piece of adhesive plaster. You perceive that the limb is thus securely placed; the articulation exposed to your inspection and to the application of local remedies; the extension entirely under control, may be increased or diminished as the case may require. The water-bed secures cleanliness in case of suppuration, and the elastic extension and counter-extension enables you to move the articulation as often as is needful to prevent anchylosis.

Angular contraction of the Knee-Joint with Anchylosis.

If no attention be paid to the gradual contraction of the hamstring muscles, the affected articulation may recover by anchylosis and a permanent angular deformity.

Simple arthro-meningitis (synovitis) most usually terminates in *fibrous adhesion* of the articular faces, (false anchylosis.) According to the angle of contraction, different points of the articular faces may become thus agglutinated. In the right angle, for instance, the posterior circumference of the condyles rests on the tibia. The patella usually becomes adherent to the external condyle of the femur. These anatomical relations are naturally modified if the tibia be likewise rotated on its longitudinal axis and the toes everted, which is mostly the case.

Suppuration of the joint, or pyo-arthrosis, as it is called, does not necessarily lead to the other form of anchylosis. We have, in such cases, freely opened the articulation and allowed the joint to fill up by granulation. Repeated gentle movements effectually prevented the consolidation of the inter-articular effusion. It remained, consequently, fibrous, and allowed a certain degree of mobility. This is a desirable result. If a straight position be likewise secured by proper local treatment, the extremity, for all practical purposes, is rendered useful.

Periostitis of the femur or tibia near the knee-joint generally gives rise to the formation of *osseous bands* (osteophytes) that cross the joint

and cause perfect immobility. In as far as the articular faces have remained intact, this form of anchylosis is remediable.

Disease of the bones themselves most usually terminates in the establishment of a bony union, (true anchylosis.)

The treatment of spurious anchylosis of the knee-joint, complicated with angular contraction of the extremity, may be effected by *gradual and increased extension*, or by *forcibly breaking up* all the impediments to mobility.

Gradual extension, for the purpose of overcoming fibrous anchylosis and angular deformity, is an old surgical proceeding. Although repeatedly renewed and combined with friction, steaming, and numerous other local applications, it has never become popular among surgeons. From our introductory remarks you easily understand why such a method must be tedious and inefficacious; but, what is worse, it is extremely painful and dangerous. If but a moderate degree of extension be employed, its effect is nought; whereas severe extension is so excessively painful that no patient can bear it. There is not only danger of sloughing and extensive excoriations from pressure of the mechanical appliances, but the reaction upon the nervous system is frightful. Twenty-four hours' severe extension will more than suffice to throw the constitution of any patient out of its ordinary course. Next, there is the danger of reproducing the original disease from whence the anchylosis and deformity resulted. Our experience, therefore, is not of that description as to encourage the treatment of the like deformities by gradual extension.

The same want of success seems to have induced some surgeons to combine with progressive extension the tenotomy of the retracted tendons. As early as 1810, Michælis divided the skin and incised tendons and muscles in a case of scrofulous anchylosis of the knee, and reports, in the *Medico-Chirurgical Gazette* of Salzburg, of the same year,* that the result had been most satisfactory.

Dupuytren and Delpech performed tenotomy by a more accomplished method for the same object; but with Stromeyer's improvements of that operation, the treatment became more systematized.

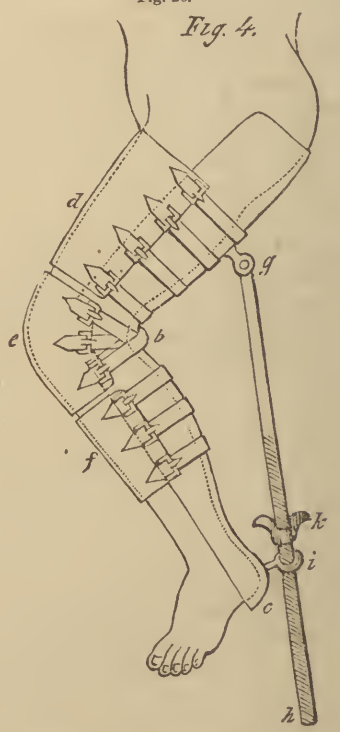
* Vol. i. page 383.

M. H. Chase* and Lorinzer† still hold that the division of tendons is unnecessary; and the latter thinks that it materially protracts the recovery of the patient.

The biceps has been most frequently divided; after that the gracilis and semi-tendinosus muscles. Palasciano is of the opinion that the division of the quadriceps muscle is an indispensable preparatory measure in order to loosen the knee-cap. Bonnet favors the same opinion, but prefers a different operative plan.‡

The apparatus devised for gradual extension of the knee-joint are very numerous, and some of them most ingeniously constructed, Fig. 26.§

Fig. 26.



They have all, however, been superseded by the more simple, milder, and not less powerful pulley and weight. As a general method for the treatment of contractions at the knee-joint, the progressive extension even in connection with tenot-

* American Journal of Medical Science, 1841.
† Ueber die Behandlung und Heilung der Contracturen in Knie-und Hüftgelenke. Vienna, 1849.
‡ Traité de Thérapeutiques des Maladies Articulaires. Paris, 1853.
§ Apparatus of Robert.

omy is not commendable, because it is too tedious. But there are cases in which it may be considered indispensable; for instance, extensive scars in the neighborhood of the joint, the result of suppuration or burns. Here the knife can do but little, and extension therefore is opportune.

Forcible extension seems to be likewise an old and popular treatment. In every country, almost, some persons have been noted for their usefulness in setting bones and straightening joints. The shepherds and the schinderknechte of Germany made and make still quite a business of it, and some have acquired reputation and wealth thereby. Similar individuals act in the same capacity among us, and pretend to great ability by intuition. At an early period Amussat reported to the Academy of Medicine that there was a surgeon in Paris who had forcibly extended the contracted knee of a young girl, at which occasion a crackling had been distinctly heard. The child died in consequence of the operation. These were all, however, but erratic attempts to master the existing difficulty; but with Louvrier, a young physician of Pontarlier, the method of brisement forcé acquired a more tangible form, (1839.) As a matter of course, the opposition which he encountered was considerable, but equally enthusiastic in behalf of the new method were his friends, and thus he engaged, at last, the interest of the Academy of Medicine. The apparatus which he employed was complicated and clumsy. The results were imperfect. In all his cases the knee-joint did not attain a good form. Some limbs were not perfectly straight. Out of twenty-two cases, three died. In some purulent infiltration occurred. Owing to the imperfection of his proceeding, the extension, in some, terminated in posterior subluxation of the tibia, Fig. 27, as was subsequently verified by post-mortem examination. Notwithstanding all the imperfections, Louvrier has certainly deserved well for the establishment of an orthopædic method which, by gradual improvements and additions, constitutes in our day a most powerful and efficacious remedy in a class of difficulties which had been hitherto unmanageable. Nor can the discretion which he observed, and the candor with which he admitted the shortcomings of his efforts, be too highly appreciated. Among his most determined opponents at the time were Ferguson and Stromeyer, both of whom, in not very flattering terms, disposed of his method. Dieffenbach was, to our knowledge, the first surgeon who not only vindicated, but had the courage to adopt it, although he added tenotomy. In a comparatively short time this distinguished surgeon had operated upon 200 patients, and reports the general result in his work on operative surgery, to the effect that he lost but two patients by suppurative exhaustion. That amputation was required in one, that in some the limb was improved to a moderate degree, in others anchylosis became re-established. A large proportion of the patients were materially benefited.

Fig. 27.

Fig. 1.

Some advancement has this method of treatment received at the hands of Professor Bernhard Langenbeck, of Berlin, but it should be remembered that he had a most powerful aid-de-camp, namely, chloroform. In his inaugural dissertation, in entering upon his professorship,* he pronounces gradual extension ineffective; the division of the contracted muscles, as performed by Dieffenbach, as superfluous, and even dangerous, by inviting the entrance of air and thus giving rise to suppuration. Louvrier's method is, according to him, too uncertain, and its results removed from the control of the surgeon. The technicism of Langenbeck conforms, in most points, with those of Dieffenbach. The results which Langenbeck attained up to 1853 are compiled in the inaugural dissertation of Philipp Frank.†

In carefully analyzing the results of Louvrier, Dieffenbach, and Langenbeck, and in comparing them with each other, it cannot be denied that Dieffenbach's were superior to Louvrier, and Langenbeck's better than his predecessors. But all of them are certainly imperfect, and by no means satisfactory. Louvrier caused, in three cases, considerable injuries to the knee-joint, and consequently lost them. Of what nature these injuries were we have not learned, nor the reason why they happened in three cases, and not in the remainder. Very likely that they were cases of

* Commentatio de contractura et anchylosi genu nova methoda violentæ extensionis ope curandis. Berolini, 1850.

† De contractura et anchylosi articulationis genu et coxæ; Berolini, 1853.

true anchylosis, and that he fractured the bones, or caused diastasis of the epiphysis, or tore vessels or nerves. The subluxation of the tibia, in almost all the cases of Louvrier, must have been a great detriment to the final result of his treatment. For, in the first place, the posterior projection of the tibia must have, by necessity, compressed the popliteal nerves and vessels, thus materially interfering with the circulation and innervation of the leg. Again, the gastrocnemius was evidently put on the stretch, and the heel prevented from reaching the ground. Moreover, the contracted flexor muscles were so much irritated as to cause serious subsequent troubles. Dieffenbach's method was, therefore, a material improvement. In using *manual* force alone, he protected himself against the error of meddling with cases of true anchylosis, not amenable to brisement forcé, and by dividing the contracted muscles, he relieved the patient from the serious consequences appertaining to undue extension. Lastly, in breaking the anchylosis up, by alternate flexion and extension, he obviated subluxations of the tibia. The real merits of Louvrier or Dieffenbach for the advancement of this province of orthopædic surgery are, in our humble judgment, obviously greater than those of Langenbeck. The method of the latter is essentially that of Dieffenbach deprived of the benefit of tenotomy, but favored by chloroform.

We have the most unreserved appreciation of the great talents and diligence of Langenbeck, to whom surgery is greatly indebted for many of its improvements, but we appreciate truth and clinical facts still higher. About 500 cases of affection, contraction, and anchylosis of the knee-joint have given us ample opportunities for most thorough clinical observations, and entitle us to a participation in the settlement of the important question, which is still being discussed by the highest scientific tribunals of Europe, and before which Langenbeck maintains his former position.

On the feasibility of brisement forcé we all agree. Its superiority over progressive extension can no more be questioned, and its former opponents have been effectually silenced by the overwhelming results of that practice. It has also been clearly demonstrated that the hand is a better mechanical adjuster than the lever and the screw. But for the introduction of anæsthetics, more especially of chloroform, the operation would have been of little practical value. The pain attending it is severe enough to terrify the boldest patient and surgeon. The subsequent sufferings it entails, and the uncertainty of its success, would have driven it again into oblivion. Chloroform and tenotomy alone have secured the future of brisement forcé. The former renders it perfectly painless, the latter protects against consecutive effects, which are worse than anchylosis and the contraction of the knee-joint together. We do not dispute that, in some instances, simple extension will suffice to overcome permanently a moderate reflex contraction. Further, we have observed that a weight of a few pounds fastened to the extremity for a few days will have the same effect. But a high degree of muscular contraction can be subdued by division only. The name of Langenbeck was sufficient inducement for us to follow his directions. We tried his method in quite a number of cases; we succeeded, in most of them, in extending the extremity, but as soon as the anæsthesia subsided, the muscles commenced contracting again, or, if prevented therefrom by mechanical restraint, an intense suffering ensued. There are but few maladies that cause so intense agony, and prostrate the constitution in so short a time, as the persistent extension of contracted muscles. We remember, among several cases, particularly one of a little boy, who was brought on from Montgomery, Alabama, with a contraction of the knee-joint. The original disease, synovitis, had subsided two years before. The joint was quite well, and there was no pain felt either on motion or pressure. Moreover, the mobility of the joint was not materially disturbed, beyond the impediment of the contracted flexors. Under chloroform only the biceps muscle felt tense, and we divided it. We then easily succeeded in extending the leg, and in securing its position in a straight splint. The anæsthesia had scarcely passed off, when the patient began crying loudly, and very soon the articulation became tender and distended. Inflammatory fever set in, with a pulse of 150. The strongest opiates, the most active and persistent general and local antiphlogosis made no impression whatsoever. The paroxysmal pains suggested to our mind their specific character. On relieving the limb from its restraint, it immediately bent. This was another indication in the same direction, and yet the tension of the remaining undivided flexor muscles was so trifling as scarcely to deserve notice. On the sixth day after the operation, the joint was greatly distended and fluctuating, with-

out the slightest sign of amendment. At that juncture, we again placed the patient under chloroform, when again all muscular tension vanished, and we had to wait for the subsidence of anæsthesia in order to mark the tendons to be divided. What sedatives and the whole antiphlogistic apparatus failed to effect, tenotomy did. Rest immediately ensued therefrom. From that moment improvement commenced, and eventuated in perfect recovery. We could adduce several instances of the same striking and conclusive nature. But one will suffice to illustrate the importance of tenotomy in the treatment of the deformity under consideration. We shall now proceed to delineate the plan which we have adopted, and which we have reason to believe is the mildest, the safest, and certainly the most effective. First, be certain in the diagnosis. Fibrous anchylosis may be easily recognized, for there always remains a moderate degree of mobility at the joint; even osteophytes are not incompatible with mobility, more especially when they arise from one bone, and do not firmly connect with the other. But if both bones are united by osteophytes, there is nothing left of mobility, and in as far as the latter is concerned, there is no symptomatic difference between a true anchylosis and that caused by osteophytes. The previous history of the case alone can give you a clew as to the nature of the anchylosis. From our preceding remarks you may be led to expect osteophytes from previous periostitis, and true bony union from a more structural affection of the joint itself. Supposing, then, that we had either a fibrous or an osteophytic anchylosis, with marked contractions of the flexor muscles, we would suggest, first of all, to divide all the contracted muscles. It will be better to do this six or eight days previous to the performance of the brisement forcé. By that time the wounds have firmly closed. No air can enter and give rise to suppuration, and you obviate at least one of the objections raised by the opponents of tenotomy. It is, of course, indifferent whether you use chloroform on that occasion, since but little pain accrues from the operation. Nor do we deem it necessary to give you special advice as to the flexor muscles of the leg, since by extension you can raise them from the adjacent parts, and divide them successively as they present themselves. The division of the tendon of the biceps deserves special mention. The external popliteal or peroneal nerve is in such close approximation to the internal margin of the tendon as to be easily cut through. If this be the case, paralysis of the abductor muscles of the foot and talipes varus would, inevitably, follow. In order to avoid this nerve, you have to divide the tendon either from outside by dead pressure with a tenotome not too sharp, or by inserting it close to the inner margin of the tendon, and give the edge an outward direction.

But if there be no trace of mobility in the joint, as in complete osteophytes, the brisement forcé should precede the tenotomy, for reasons that require no further explanation.

In order to perform brisement forcé, the patient should be fully under the influence of chloroform. He should be placed on his face, but at the same time due attention paid to respiration, for at that degree of anæsthesia respiration is very feeble, and in the main diaphragmatic. The slighest impediment may entirely arrest it. As soon as the patient is thus prepared, you have the thigh properly fixed by an assistant, and then taking hold of the leg, bend it with a sudden jerk, and thus extend it; and so continue to alternate between flexion and extension, until the articulation is quite free. If there be any rotation of the tibia, it will be advisable to amend that position by retwisting it in the opposite direction. This done, bandage the extremity carefully with a roller, surround the knee-joint with strips of stout adhesive plaster, and fasten either the extremity in a straight iron splint, such as you see before you, or adjust the extension with the pulley and weight, as before described. In order to correct the lateral position of the limb, Professor Robert places side cushions inside of the splints before fastening the extremity, and has obtained good results thereby.

With this plan we have obtained most satisfactory results, and have never had any trouble in producing a speedy and steady recovery of numerous patients. It was never followed by inflammation or neuralgia, that other surgeons have complained of; nor did the contraction return, provided all the contracted muscles had been successfully divided. If any of those symptoms should set in, rest assured that the tenotomy is not complete. The earlier you perfect it, the better it is for your patient. It is needless to contend against them by antiphlogistics and sedatives; you will effect nothing. Tenotomy is the only remedy.

Most patients are quite satisfied with a straight and stiff limb. The after-treatment requires

then very little more than an instrument affixed to the limb, which we here exhibit, Fig. 28. It consists, as you perceive, of two straight pieces of steel properly adjusted to the form and length of the extremity. It should extend from the upper third of the thigh almost to the ankle-joint. The splints are connected by four iron bands embracing the posterior half of the member, of course well padded; the anterior half is completed by a broad leather belt. A knee-cap, made of stout buckskin, which combines both firmness and elasticity, to be fastened to the splints, should prevent the knee from bending. The same apparatus answers equally well in the after-treatment of transverse fracture of the patella. The extremity thus secured and protected against incidental motions will enable the patient to walk a week or fortnight after the operation, and he should wear it until the knee-joint is perfectly anchylosed. If, however, the patient desires the re-establishment of articular mobility, and his case is favorable, the after-treatment will necessarily be more tedious. You will, in this instance, keep the extremity for a longer period under elastic extension and counter-extension, while daily passive motion must be instituted. You may combine it with inunctions of appropriate liniments with warm local baths, and expose the joint to hot vapor and other remedial substances which you may deem proper. Time and perseverance, united with discretion, will achieve much benefit for your patient.

The brisement forcé is in appearance and reality a powerful remedy. It overcomes, by main force, all resistance; it ruptures the fibrous adhesions of the joint and unyielding tissues, and can certainly do great mischief if indiscreetly performed. But in using the necessary precautions with physical power, nothing is to be apprehended therefrom. In the large number of our cases we had but two accidents: one of them was inevitable, and certainly could not be foreseen. The case refers to Patrick Feeney, a youth of about sixteen years. He was tall, slender, and evidently of feeble constitution. Having been employed in a manufactory in which he had to tread a wheel, he had thus acquired an inflammation of his knee-joint, which terminated in a deformity. His leg was bent at an angle of 105°, but permitted mobility within an angle of 30°; beyond which there was resistance on the part of the contracted biceps, and some other articular impediments. The patella was moderately movable. After having divided the tendon of the biceps, we increased the flexion

Fig. 28.

Fig. 3.

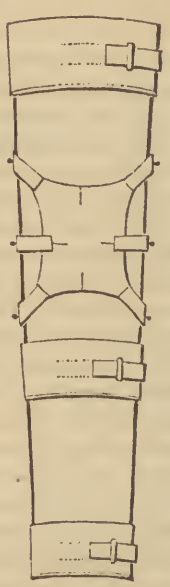


Fig. 29.

of the limb by a comparatively gentle effort, when, to our surprise, the resistance suddenly yielded. A few days afterward a slough appeared in the popliteal space, and the suppuration became so profuse as to render amputation imperative. It was then found that the epiphysis of the femur had yielded, whereas the articular adhesions had remained unbroken, Fig. 29. The disproportionate strength of the articular adhesion, over and above the union between the lower extremity of the femur to its shaft, was the proximate cause of the accident, and certainly could not have been anticipated. A large proportion of our patients have been children where the same condition of the femur existed; yet we never met with a similar accident, nor have we found anything like it recorded in medical literature.

A moderate physical force is sufficient to fracture osteophytes, at least we have found it so. Should you not succeed in accomplishing your object, try it again; but do not employ violence, for you might fracture the bones. Some years ago, Dr. Moses invited us to a proposed exsection of the knee-joint, at the "Jews' Hospital," for true anchylosis. The limb was in a flexed position and the articulation absolutely immovable;

but the entire absence of scars and the previous history of the case suggested periostitis as the remote cause of the trouble. Before the intended operation was commenced, Dr. Moses, with our advice and assistance, attempted to extend the limb by brisement forcé, *and succeeded*. The crackling heard upon that occasion by all present left no doubt that the articular impediments consisted in isolated bony connections, and probably in osteophytes alone.

In extensive and complete osseous union of the knee-joint, brisement forcé is of course ineffective. Rhea Barton's operation alone is calculated to meet the emergency. Although originally proposed for the relief of anchylosis of the hip-joint, its author conceived the practicability of the operation in the same morbid condition of the knee-joint. In 1835 he, for the first time, performed the exsection of a wedge-formed piece of bone from the knee, and the result attained was highly satisfactory. The wound closed in two months, and in five and a half months the patient resumed his avocation as practicing physician.

The second operation of this kind was resorted to by Prof. Gibson, of Philadelphia, and likewise terminated favorably, the patient being capable of walking without crutches five months after.

The third operation Dr. Gordon Buck successfully performed at the New York City Hospital in 1844. The patient subsequently sustained a fall from a ladder and fractured the new union; recovery ensued without any untoward incident.

Since then the same operation has been repeated by Mütter, Bruns, (Tübingen,) Heuser, B. Langenbeck, Ried, Robert, Post, (New York,) and others. As far as we have ascertained, but two cases proved fatal, (Bruns and Post;) the balance recovered with useful extremities. The technicalities of Barton's procedure may be found in every work on operative surgery.

Prof. Brainerd, of Rush College, has, some time ago, suggested weakening the inter-articular substance by drilling it in various directions through a small wound, and then to fracture the rest. How many operations have been made according to this plan, we do not know, but its application signally failed in a case of one of our most accomplished surgeons, (Prof. Gross,) and a chisel had to be resorted to, which was driven through the bony connection.

A similar proceeding had been proposed by Prof. Shuh, of Vienna, as early as 1853, but did not meet with the approval of German surgeons.

Whether the recently introduced so-called osteoplastic operation of B. Langenbeck has been attempted in true anchylosis of the knee-joint, we are equally ignorant, but apprehend that a simple separation of the articular faces by drill or saw will scarcely suffice to give a good form to the extremity, the new bony substance being an impediment; and, therefore, we would prefer, of all the methods suggested, that of Rhea Barton, which has proven itself both effective and comparatively harmless.

MALPOSITION OF THE KNEE-JOINT FROM BURSAL DISTENTION.

Bursitis, as the remote cause of malposition of the knee-joint, has, heretofore, been entirely disregarded. Cases of this kind may not be numerous, but they are certainly very intricate, and not rarely baffle the most sagacious and skillful surgeon.

Not every bursitis, in the vicinity of the knee-joint, is alike capable of exercising the same prejudicial effect upon its position. The so-called housemaid's knee (Hygroma patellare) may acquire a considerable size, without disturbing in any material degree the position of the articulation. Inflammation and distention of the slides at the tendons of the hamstring muscles are equally ineffective, in as far as the position of the knee is concerned. But if the subcrural bursa is affected and greatly extended by an excess of its secretion, the mechanical consequences are very great. It will be remembered that the aforesaid bursa is placed in close approximation to the knee-joint in front of the femur, and designed to facilitate the movements of the quadriceps muscle. Sometimes there is a communication between the articular cavity and this bursa, which tends to enhance the pathological importance of the latter. In each anatomical relation the inflammation of the one may easily extend to the other, and the copious collection of fluid in the joint may be forced into the bursa, and vice versa. The extraordinary cases of hydrarthrosis of the knee, mentioned by Dupuytren, Boyer, and others, not unlikely implicated the subcrural bursa, which may be deduced from the extent of the swelling in front of the thigh.

If, however, the *completely isolated* bursa should be the seat of subacute inflammation, and become distended by a large quantity of fluid, as

we have observed it in two instances, the bursa is converted into a roll that raises the quadriceps off the femur, displacing it laterally, at the same time changing the direction and effects of its action. This is more readily the case when the bursal sac has become thickened by the morbid process, and distends chiefly in one direction. It assumes, then, the shape of a hemisphere, with its broad base firmly attached to the periosteum.

While the quadriceps acts over this as over a pulley, its physical power is greatly enhanced by this mechanical arrangement. But the increase of its power is the very reason why it gradually slides into a lateral position on the outer aspect of the thigh, drawing the patella along toward and upon the external condyle of the femur, still deriving mechanical advantages from the bursal tumor. By this shifting of the muscle the quadriceps becomes *acting flexor* of the leg, and its lateral location has the simultaneous effect of *inflexing the knee toward the other extremity.* The remote consequences may be easily realized. The extremity, being bent and knock-kneed, is thrown out of its perpendicular, the internal lateral ligament of the knee-joint has to bear the weight of the body, and becomes inflamed and excessively painful; the inflammation extends over the joint, adhesions of the articular faces ensue, and the member becomes, at last, useless for the purpose of locomotion.

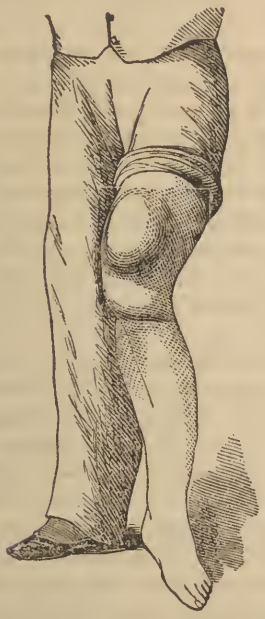
There is yet another peculiarity in such cases that well deserves to be mentioned, namely, the *extraordinary hardness* of the bursal tumor, so as to simulate bone itself. This very hardness it is that often misleads the best surgeons to an erroneous diagnosis, and deprives the patient of the chances of relief. The following history of a case of this kind that came under our charge will exemplify the difficulties with which the like cases are surrounded, and the treatment pursued will serve as a guide in similar maladies: The patient (Peckner) was a young man, twenty-two years of age, when, three years ago, supported by two crutches, he limped into our office. Although of tolerably strong frame, he appeared much reduced in weight, greatly debilitated in vital powers, with a pallid and melancholic countenance. The marks of intense and protracted suffering, mixed with utter hopelessness, were deeply engraved upon his physiognomy; both from the constant pain and the deformity of his extremity. The patient related his case in the following words: "At the age of eleven I received an injury upon my left knee, which troubled me for three successive years, without, however, depriving me of locomotion. At that period, my father, a sea-captain, took me on a voyage for the benefit of my health. At sea I had repeated falls, not unlikely concerning also my weak joint. One day I was engaged in driving nails, the hammer slipped, and gave me a hard blow in front of my thigh, right above the left knee. The pain I experienced at the time was keen, yet tolerable, and, at any rate, bore no comparison with the agony that ensued very soon after. Moreover, my knee swelled considerably, assuming, at the same time, a bent and knock-kneed form. I cannot place the affected leg upon the ground without the most intense pain at the inner side of the joint and upward, and I have, therefore, to swing it with the aid of crutches. In touching my leg accidentally, and during sleep, when I turn in bed, the agony is great and almost unbearable. During the eight years that I have been an invalid, my father has taken me to, at least, a dozen surgeons of high repute, both in Europe and the United States, and their conjoint advice was 'amputation.' I could not familiarize myself with the idea of becoming mutilated, and despite the unanimous professional advice, I still nurtured the hope of attaining relief without loss of limb." The patient concluded his dismal history with the laconic question, "Can you cure me?"

The photograph which we invite you to inspect gives an accurate representation of the deformity of the patient, Fig. 30. You notice in front of the left thigh, close to the knee-joint, an oval, circumscribed, and prominent tumor, $9'' \times 4''$ in size. Said tumor presented a smooth surface, a broad base, and everywhere the same hard, unyielding surface. It seemed to be made up of bony material. There was no discoloration nor tenderness observable, nor could the tumor be moved at it base, whereas the integuments could be readily shifted. The only tender spot of the affected extremity was at the inner aspect of the knee-joint. The latter was anchylosed by fibrous bands, allowing still a moderate mobility. The biceps femoris was contracted; the leg was rotated outward at the knee-joint, and the toes had thus become everted. The entire extremity was moderately attenuated. This completes the picture of the case.

One thing seemed to be certain, namely, that the tumor was accountable for the existing de-

formity, and that the latter was to be identified with the mechanical effects of the lateral displacement of the quadriceps muscle. The other symptoms characterizing this case could be readily accounted for as the remote consequences of the existing mechanical derangement. The inflammation of the knee-joint might have ex-

Fig. 30.



ceeded the limits of fibrous adhesion but for the timely suspension of its use. But what was the nature of the tumor, and was it susceptible of removal? That was the all-important question.

The apparently hard texture of the morbid growth suggested bony structure. Was it an ostcoid? We thought not. Because the patient exhibited no *cachectic* signs. In his family no *hereditary* taint could be traced. Nor could the long existence of the tumor be reconciled with a cancerous neoplasm. Above all, the growth was *too firm* for osteoid.

Was it a periostosis? This diagnosis, though otherwise plausible, could not be adopted, on account of the regular form and the extent of the tumor, chiefly in one direction. Moreover, periostosis was certainly incompatible with the broad basis of the growth, instead of encircling more or less the entire femur.

Was it a bone abscess? No! the bone would have distended its walls in all directions, and become rarified and soft by such a size.

It might be sarcoma or fibrous growth but for the hardness, smoothness, regularity of form, and its scanty endowment with vessels. We admit, however, that neither of those differences would be decisive in differential diagnosis, as we now understand the pathological condition of the case, for the same mechanical influence that gave the hard feel to liquid is likely to produce the same effect upon semi-solid structure.

The evidently traumatic cause, the gradual increase, the regular form of the tumor, and the anatomical region pointed directly and conjointly to the distention of the subcrural bursa. Yet there was no fluctuation, and that ominous hardness was left unaccounted for. Nothwithstanding the discrepancy, we commenced most carefully to explore our ground, with the hope of detecting fluctuation; for the rather indefinite supposition suggested itself, that *the resistance of the vagina femoris* might both render the tumor hard and obscure its fluctuation.

At the inner and lower aspect of the growth, a branch of the saphena magna perforated the aponeurosis and dipped into the depth. There we felt some elasticity and very indistinct fluctuation, sufficient evidence of fluid, at any rate, to warrant explorative puncture. The patient, a very intelligent young man, having realized the probable character of his case, and deriving new hope from the proposed proceeding, readily consented to the exploration.

After having made the necessary preparation, we proceeded next day, with some of our professional friends, to the patient's dwelling. We must confess that we met with but little encouragement for the operation, either on the part of our colleagues or the relatives of our patient. The former *dissented* in toto from our suggestive diagnosis, and the latter presented the authority of the best surgeons of the country as objection to any other proceeding short of amputation of the thigh.

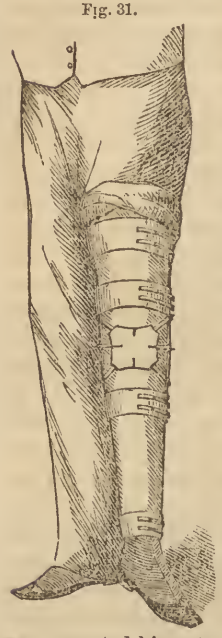
The trocar being inserted, about ʒxiv of a straw-colored and alkaline fluid was withdrawn, whereupon the tumor collapsed. On careful examination, the empty sac and its contours could still be discerned; but, of course, the previous hardness had entirely vanished.

Having thus verified our diagnosis, we proceeded with the second part of the programme, *in dividing the outer hamstring, breaking up all articular adhesions, and in fully extending* the extremity. A few minutes served to change the condition of the patient, and infused him and his

friends with new hopes for the future. It could hardly be anticipated that pressure alone would suffice to prevent the reaccumulation of the bursal fluid. In order to close up the old depot, we were induced to inject tincture of iodine.

That operation was followed with violent inflammation and suppuration of the bursa. When, at last, the cavity had closed, the quadriceps muscle was so firmly agglutinated to the thigh-bone that it seemed indifferent whether the articulation of the knee-joint was re-established or not. The patient, desirous for active life, declared himself quite contented with a straight, useful, and painless, though inflexible extremity, with which he is now able to walk his forty miles a day.

Fig. 31.



The presented photograph, Fig. 31, is the appearance of the patient at the discharge from our treatment. At that time, we supported his extremity with a straight apparatus, with which the patient now dispenses.

That the hardness of the tumor was simply caused by the constraint and resistance of the vagina femoris, will be admitted without further dispute. And we noticed the *same symptom* in the case of Mr. A., one of the great hotel proprietors of New York. We need hardly say that the correct diagnosis of Mr. A.'s case depended likewise on correct discernment of the tumor, about whose character and structure conflicting opinions and apprehensions had been advanced. We were fortunate enough to aid in the diagnosis, and to contribute an indirect share to his relief.

PARALYTIC CONTRACTION OF THE KNEE-JOINT.

This subject will occupy our attention but for a brief space of time, having already, in a previous lecture, advanced the general physiological and pathological principles appertaining to motor paralysis; the symptoms of which are so uniform that the special parts affected make very little difference.

The more common paralytic deformity at the knee is that of flexion, although combinations with ad- or abduction are observed. The degree of flexion varies greatly from a slight deviation to an acute angle, so as to bring the foot in contact with the nates. It is not often that we meet with this simple deformity; it mostly appears in conjunction with others in the same or both extremities, from the hip downward to the toes. Distortions of this kind deprive the patient completely of not only locomotion, but constitute an unsightly appearance. Fortunately they are not very frequent, although they may be seen in large cities in quite a good number, where they collect for the purpose of invoking the sympathies of the charitably disposed. For this reason, they are exaggerated by artificial appliances. In New York, and still more in London and Paris, these wretched individuals may be seen on the sidewalk, walking on their hands and buttocks, while their legs, thin as broomsticks, are buckled to their thighs.

Most of these cases commencing in early childhood, and depending on maladies of the nervous centers—more especially of the spinal cord—spontaneously and gradually improve. Sensation may return, and the non-contracted muscles may resume their motor office; but the contractions remain, and with them the attenuation of the extremities and their arrested growth. The symptoms attending these cases depend, of course, more or less on the degree, extent, and duration of the paralysis. If the motor paralysis be complete, and of long standing, the extremity is shriveled to almost nothing; its contours are destroyed, and its circumference may be reduced to little more than that of the bones. The condyles and epiphyses protrude; the skin is wrinkled, flabby, cold, dry, and mottled; the paralyzed muscles seem to be almost annihilated, and the contracted ones appear like tense cords between their respective points of insertion; the deformity is in accordance with the group of muscles contracted. Thus if the adductor muscles of the thigh be contracted, the extremities are firmly pressed against each other, impeding thereby the discharge of urine, and, in females, the menstrual flow, producing constant excoriations at the groins. If the flexors of the thigh be likewise implicated, the limbs are drawn up, the knee approximating the face. If talipes equinus be coexisting with contractions of the knee-joint, the plantar surfaces of the feet are pressed against the nates, etc. Modifications in the deformity are numerous,

and may be easily imagined. The only muscles which are exempt from the paralysis of the lower extremities are the psoas major and the illiacus; perhaps, from the fact that at least one of them derives its nervous endowment from the lumbar nerves. Their physiological integrity is exceedingly valuable for locomotion by the aid of artificial appliances.

The bones are, for the most part, retarded in their development, their epiphyses being rather smaller, notwithstanding their protrusion. Occasionally we find the bones bent, and their articular surfaces altered, as the necessary consequence of a persistent muscular traction and position.

The prognosis of the like cases is self-evidently a bad one. If it be already impossible to relieve the central disease after a long existence, it is alike impossible to re-establish the muscular structure which has become deteriorated into adipose or fibrous tissue. Nor can we, in any way, influence the arrested growth and development of the limb. All that art can do for such cases is the relief of the existing contractions by tenotomy, bringing the extremities into a straight position. This should be distinctly understood, and no encouragement held out beyond that.

After the extremities have been straightened, an apparatus may be affixed to the body, commencing with a belt round the pelvis, and a straight brace down to the foot firmly fixed to a boot. The limb, of course, is to be fastened to the brace by transverse bands. With the aid of crutches, the patient may use his extremities to a moderate degree. If, however, the muscular structure be only in part paralyzed, the apparatus may be made with joints, and supplied with India-rubber bands longitudinally fixed, to be used as muscular substitutes.

Whether extension should be employed previously to the application of mechanical means, or whether the local treatment of the paralysis should be resorted to, depends entirely on the feature of the case. At all events, while using the mechanical appliances, the limb should be kept warm by a flannel bandage or worsted stocking, and carefully protected against chafing.

KNOCK-KNEE (GENU VALGAM.)

This deformity consists of an incurvation of the knee-joint, and, as the popular name indicates, brings the articulations in such close proximity as to interfere with, or knock against each other in walking. Sometimes but one extremity is thus afflicted, but often both. Such a case we have lately treated in this institution, and you will readily recognize your old acquaintance in this photograph, Fig. 32. We have ac-

Fig. 32.

quainted you with the fact that the Ethiopian race and Jews have a hereditary disposition to this deformity. In many instances knock-knee is the superadded complication of talipes valgus, and in a fraction the deformity seems to be strictly idiopathic. The latter type occurs most frequently among lads during the period of puberty, when their growth is rapid, the leverage of their bones great, their muscular power feeble, and when they are overtaxed by lifting or carrying too great weights, more particularly on one side of the body. Hence the deformity is observed among the apprentices of lock and blacksmiths, treading the bellows with the right leg; among errand-boys of tea or grocery stores, porters, etc.

It has been suggested that the proximate cause of knock-knee depends on an arrest of development of the external condyles of both the femur and tibia, and on overgrowth of the internal ones of these bones. We are, however, of opinion that these changes in the articular faces of the knee-joint, especially in old cases, are more the effects than the causes. For the

articulation in knock-knee is rather loose and weak; it is not strictly incurvated, but both incurvated and longitudinally rotated; it is gradually superadded to pre-existing talipes valgus, and mostly remedied with that deformity. It is acquired by overtaxing the joint with too heavy weights at a time when it is still weak, and in general it can be relieved by mechanical means exercising no direct influence upon the shape of the bones, excluding, of course, the rachitic species of the deformity.

A careful examination of the trouble, under a proper degree of extension and counter-extension of the extremity, will disclose, as the direct cause of knock-knee, a marked contraction of the external duplicature of the vagina femoris inserting at the capitabum fibulæ, and occasionally a contraction of the biceps femoris muscle. We are somewhat at a loss to account for these shortenings, unless we have to recognize in them reflections from preceding inflammatory irritations of the joint by the malposition, which, indeed, we have repeatedly observed, terminating in fibrous anchylosis.

Fig. 33.

To enter upon the symptomatology of the deformity, and to qualify its impediment in locomotion, seems superfluous, since you meet cases of the kind in the streets almost every day. We have often heard the opinion expressed, that this malposition will be outgrown, or, in other words, spontaneously corrected. This is a serious error. We should lose no time in mending the deformity. In waiting, we allow the originally moderate malposition to advance to a formidable difficulty, in which gradually the articular surfaces may participate and render the case incurable.

The treatment of knock-knee presents little difficulty. Divide the duplicature of the fascia lata right above the joint, and, if necessary, divide also the tendon of the external hamstring. Allow a few days to elapse after the operation, until the wounds have healed. Then apply a well-padded splint of sheet-iron externally to the extremity, and bandage it tightly up, particularly at the knee. You may combine with the splint longitudinal extension by pulley and weight, or use weights both longitudinally and transversely. The latter treatment we employed in the last case, and you are aware of the perfect relief of the deformity, Fig. 33. Of course, you have to protect the patient against a return of his

Fig. 34.

difficulty, by leather splints or plaster of Paris bandage, by invigorating lotions, passive exer-

cise, and so forth. Above all, the patient should abstain for years to come from lifting and carrying heavy weights, and had better change his occupation.

Sometimes you may meet with most extraordinary cases of knock-knee from a very different causation. You remember the case of Francis Shaw, Fig. 34, who presented himself last year at our clinic, and upon whom we performed the exsection of the entire knee-joint, as the only feasible and practicable remedy for his deformity. His knee-joint was considerably incurvated, and so loose as scarcely to permit its use. It was found that when eight years of age he had met with a fall, causing diastasis of the inferior epiphysis of the left femur. By the early use of the extremity, the trouble not having been recognized, the whole detached fragment with the joint turned toward the external aspect of the femur and united in that position, the axis of the joint forming, with the perpendicular of the body, an acute angle. The limb being worthless for

Fig. 35.

all practical intents and purposes, and the patient having attained an age to render himself useful, and, moreover, desirous to learn a trade, he cheerfully submitted to the operation. The result was every way satisfactory, the extremity being firm and inflexible, and therefore serviceable to walk and stand upon. Its shortening does not amount to more than two inches, Fig. 35.

III.—*Deformities at the Hip-Joint.*

Gentlemen :—The construction of the hip-joint is very simple. Being a ball-and-socket joint, it moves freely in every direction, and hence its susceptibility to diverse malpositions.

From the valuable experiments of Weber, it seems conclusive that its firmness depends preeminently on atmospheric pressure. In motor paralysis, however, the joint becomes so very loose that the femur may be almost dislocated at will—a fact which obviously indicates that the muscles of the joint are co-operative in its firmness.

The deformities at the hip-joint arise chiefly from two causes, namely: paralysis with contractions, and diseases of the joint and its immediately adjacent structures. With the former we shall consume no more time, having already acquainted you with their pathological features and treatment as far as needed for strictly practical purposes. To enter more deeply upon a discussion of the latter we feel the strongest inducement, although the subject belongs strictly to another branch of surgery. Besides, we have already, in two different papers, expressed our special views on the pathology and treatment of hip disease, to which we might refer. A brief recapitulation of the most important points will, nevertheless, be acceptable, and we shall endeavor to keep within the boundary of our legitimate object.

With our researches, both literary and clinical, we have had a singular misfortune. Most surgeons have *totally ignored*, some have *studiously misunderstood* them; others have gone to the hard labor *of reproducing them without due acknowledgment* to their author, and but *few* have given us credit. Had our humble efforts been for selfish aim, we should feel sadly disappointed. As it is, we care but little. If we have succeeded in eliciting the true pathology of hip-joint disease, and essentially contributed to its rational and more successful treatment, the good we have wrought for science and art will assert its own position against petrified fogyism. It is, therefore, but a matter of time, and we can patiently wait. Some monographs have already issued forth on the subject, ingrafting, more or less, our

views. The old dogmas are less vigorously urged by their former advocates, and the feasibility of treating "*tubercular and strumous hip disease,*" with mechanical means, to advantage, is now seriously entertained. Thus some ground is already gained, and the progressive ferment is in full operation. But of late, the New York Academy of Medicine has given the subject its close attention in unusually animated discussions. Although some of the members still maintained the obsolete notions of the past with a tenacity worthy of a better cause, yet a close observer could not help noticing that a general change had already been wrought in the professional mind.

Most surgeons still ascribe to scrofulosis the cause of hip and other joint diseases. The fragmentary remarks made on various occasions will have intimated to you that we do not share in these general views. We are fully prepared to show that the etiology of hip disease has no connection with tuberculosis, and that the existence of the latter itself has become totally questionable by more recent investigation.

We have reserved the special consideration of this subject for a future lecture, to which we beg to refer you. While we deny to tuberculosis any part in the causation of hip disease, we do not mean to imply that vitiated nutrition is entirely indifferent or perfectly harmless. Such an assertion would resolve itself into a plain absurdity, and be in direct contradiction with clinical experience. In contaminated nutrition hip disease *may* originate; but we are firmly convinced *that the former is more often the result than the cause of the disease.* The by no means small number of cases that have come under our personal observation, and the special attention we have devoted to this particular point, have satisfied us *that most cases of hip disease were initiated by traumatic injuries.* The effects of the same, however, make their appearance at so remote a period that they are mostly forgotten, and hence have often been ignored. In order to find out the antecedent injuries, we have to recur to the past, and you will rarely fail to establish a positive external cause. In doing so, we shall leave but a small fraction of doubtful cases, which we have no alternative than to connect with contaminated hæmatosis.

The next question arising is, in which structure the disease commences? In reviewing the various structures that constitute the articulation, and in comparing their physiological character with each other, we cannot hesitate to assign to *the investment of the ligamentum teres, the greater susceptibility to inflammation* over the remaining structures. The others have not as much cellular tissue, as many vessels or nerves, which render the nutritive process more active, and therefore much more easily deranged. Moreover, the ligamentum teres is much more exposed to the effects of contusion and contre-coup. Professor Pancoast mentioned but recently a case to us, in which the intense symptoms of pain and rising inflammation after a traumatic injury, could be reduced to nothing else than a strangulation of a fold of that ligament between the head of the femur and the acetabulum. A gentle motion of the limb gave instantaneous relief. The patient had been free of any trouble before the accident, and the question of an inter-articular body would therefore not arise. Our clinical experience has greatly tended to confirm these views. For in all the affected joints which we have had the opportunity of examining, and the number has been considerable, *we have invariably, and with only a single exception, found the ligamentum teres either disintegrated or entirely destroyed,* and this in advance of the disintegration and destruction of the other tissues. In some of our cases of partial exsection of the hip-joint, the contrast between *the entire absence* of the round ligament and the *comparatively but superficial caries of the head* of the femur, was certainly very striking. What renders the inflammation of the investment of the ligamentum teres still more formidable, is the anatomical fact that the vessels for the head of the femur pass through it, and that consequently the supply to the head is impeded by morbid action. That this anatomical condition extends beyond puberty, is exceedingly probable, from the very interesting and highly instructive investigations of Dr. Geo. K. Smith, of this city. For from what other cause than the impeded supply could the shortening of the neck by absorption in fractures be derived? There can be no doubt that such an anatomical arrangement exists, as long as the head of the femur is separated from the neck by a disk of cartilage. Thus it seems to be clear why the disintegration of the ligamentum teres precedes the caries of the head of the femur, and why the caries, or rather necrosis, of the latter is the inevitable consequence of serious affections that befall the investment of the ligament, and why

the acetabulum is mostly exempt from the disease.

These views are by no means novel; they were first advanced by Boyer and adopted by other surgeons, without a sufficient clinical basis however, to be conclusive.*

The next implicated structure in hip disease is the synovial lining of the articulation. There is no reason to exempt it from a primary rheumatic affection, with its pathological consequences; but we surmise it to be a comparatively rarer occurrence than the former. Moreover, rheumatic affections of the synovial membrane terminate most usually in ephemeral and harmless effusion, (hydrarthrosis,) being the very rarest affection to which the hip-joint is subject. We have seen but one well-established case.

The inflammation of the cancellated structure is, according to our clinical experience, an equally rare disease, especially in its acute form.† The so-called interstitial absorption or osteoporosis, as the result of chronic ostitis, occurs chiefly in old age, hardly gives rise to muscular deformity, and therefore does not interest us.

Least of all is the cartilage subject to primary disease. All these structures are, of course, gradually drawn into the process of destruction, and thus the disease becomes a general one of the entire articulation, known by the name of coxarthrocace, coxalgia, arthritis, etc. *The disease may also be forced upon the joint from without by periostitis*, as we have repeatedly observed it, and, in fine, may be superinduced by the perforation of the capsular ligament by an abscess. In this respect, *hip disease may be superadded to Pott's disease* of the spine, of which we have seen and described a most exquisite case occurring in a boy.

The peculiar deformity characterizing the second stage of the disease, namely, apparent elongation, eversion, and abduction, arises chiefly from the presence of effused liquid of some kind within the joint, consequently from hydraulic pressure. This opinion is based on experiments and clinical facts, and admits, therefore, of no contradiction. Already at this stage, those reflex symptoms manifest themselves to which we have adverted in our introductory lecture, to wit: attenuation of the extremity, peripheral and nocturnal pains, culminating in tonic contraction of certain muscles, and deformities. We recollect very well the sneers with which in certain quarters our "reflex contractions" were received as the most consummate absurdity. To-day our "absurd hypothesis" has been admitted to be well founded; has been substantially approved of, and is now acted on with all sorts of splints and extension apparatus. We still smart under the concentrated abuse of the "*ludicrous innovation*," while others turn it into substantial advantages. They are welcome to the latter; but *the honor of having first elicited the true nature of those contractions, and of having established the first rational principles in treating them*, belongs to us, gentlemen, and we shall assert and maintain it.

The late and exhaustive anatomical investigations of Schwan into the nervous supply of joints and their pertaining muscles, have most opportunely furnished an anatomical key to the entire complex of reflex symptoms manifest in joint diseases. The clinical facts elicited by us at a far earlier period have now acquired *a positive anatomical foundation*.* We learn, thus, from Schwan, that the obturator nerve supplies conjointly the inner circumference of the hip-joint, the investment of the ligamentum teres, and the inner circumference of the knee-joint with sensitive filaments, and the entire group of adductor muscles of the thigh with motor fibres. This nervous supply enlightens us at once about that hitherto mysterious causation of the peripheral pain at the inner side of the knee, and the tonic contractions of the adductor muscles in affections of the hip-joint, and corroborates with anatomical accuracy the correctness of our pathological views as to the investment of the ligamentum teres being the structure primarily implicated in the disease.

Powerful as these reflex contractions obviously

* Since the delivery of this lecture, (January last,) Mr. Hilton's lecture on the same subject has been issued in the April number of the reprinted London Lancet. We are gratified to find that he has adopted not only the same views, but elaborated them in a most masterly manner. From his careful anatomical dissections of the nervous supply of the hip-joint, and the relations of its filaments to the three principal nervous trunks of the lower extremities, (sciatic, femoral, and obturator nerves,) the symptoms of pain and tonic contraction of certain muscular groups, are thus physiologically explained. In disregarding, however, the nutritive supply of the caput femoris through the investment of the ligamentum teres, he has lost sight of the early consecutive necrosis of that bone.

† In former times we were the warm exponent of Rust's views, whose inestimable surgical instruction we had the privilege of enjoying, but subsequent investigations have led us to recognize the error, that the cancellated structure is the primary seat of the disease.

* The admirable and highly instructive lectures of Mr. Hilton, delivered at the Royal College of Surgeons of England, now in process of publication in the reprint of the London Lancet, by James Herald, of New York, have, unfortunately, reached us too late in order to be made use of in our lectures. As far as we have been able to peruse them, they are in every respect confirmatory of our views, but much more elaborate. Some of his remarks we shall append whenever we deem them illustrative and desirable.

are in the second stage of morbus coxarius, they are still more powerfully resisted by the hydraulic pressure in the joint; and for this reason the pain is more intense at this juncture than in the third stage, and the deformity is not entirely governed by the contracted muscles. But in the same proportion as the effusion in the joint increases, as the capsular apparatus becomes more distended and attenuated, the hydraulic resistance diminishes. At last the constant traction of the adductor muscles supervenes, the capsule bursts, and the extremity yields to the muscular traction, becoming adducted, slightly flexed, and inverted. The position of the limb is consequently reversed in the third stage, and the pelvis has to be tilted up, in order to procure the parallelism of both extremities. As to the details of the accompanying symptoms and changes in the mechanical condition of the patient, we must refer you to our lectures on hip disease itself. The elongation of the extremity in the second, and the shortening in the third stage, are consequently apparent, and not real. If, however, the disease proceeds to the destruction of the head of the femur, or if, *by accident*, dislocation of the same upon the dorsum of the ilium is superadded, then, of course, the extremity becomes permanently shortened. The so-called spontaneous dislocation of the femur is now-a-days *an exploded notion*, deserving scarcely our further attention.

It has already been remarked that the adductor muscles are most usually shortened; the extremity is consequently drawn toward, and sometimes across its fellow. In order to render them parallel, the patient has no alternative but to elevate the pelvis on the affected side; and in order to re-establish the centre of gravity, he has to throw the spine in sigmoid form, which, however, disappears on placing the pelvis rectangularly upon a firm basis, as is done in sitting down.

In more advanced hip disease, other muscles may become contracted. This difference depends on the implication of other nervous provinces. Thus, for instance, a branch of the femoral nerve supplies the anterior portion of the articular apparatus, and likewise some of the flexors of the thigh. The posterior portion receives its nervous endowment from the sciatic nerve, and conjointly with the flexor muscles. Hence the diffusion of the disease over the joint brings into play a reflexion on other muscles. Besides the adductors, we find some of the flexors, the tensor fasciæ latæ, the rectus and sartorius shortened, when the extremity is drawn up, and may even be forced against the abdomen with a corresponding inclination of the pelvis.

The plaster casts and diagrams which we place before you will illustrate the various deformities appertaining to hip disease. In this (Fig. 36) we observe the second stage of hip disease. The limb is greatly everted and abducted, but, at the same time, strongly flexed upon the pelvis, which we do not often see at this period. The cast was taken on account of the rarity of the deformity, and belongs to a little girl, not more than three years and a half old. The next

Fig. 36.

Fig. 37.

cast is derived from a boy, six years of age. Both his hip-joints were diseased. Unfortunately, the form has been somewhat damaged, and hence you cannot clearly discern the position of the feet. But you notice (Fig. 37) that the left extremity is strongly adducted, and placed over its fellow, being, at the same time, inverted; the joint was ruptured, and we recognize, therefore, the third stage, whereas the other extremity is abducted and everted. This joint contained a great deal of fluid, which was withdrawn after the cast had been taken. In the last three (Figs. 38, 39, 40) you observe representations belonging to the third stage. The respective cases have happened in the practice of our friend, Prof. Lewis A. Sayre, who has kindly consented to the use of them for illustration on this occasion.

The first represents a little girl, about nine years old. She suffered from the third stage of hip disease, had a large abscess about the joint with which it communicated. The last two have

been taken from a man, somewhat advanced in years. The disease had terminated in anchylosis

Fig. 38.

of the joint, and the deformity was very great. We are happy to state that both cases were successfully treated by that intrepid surgeon.

Fig. 39.

Fig. 40.

The prognosis of deformities at the hip-joint is more or less blended with the prognosis of those maladies from whence the distortions originate; for the latter are more or less apt to return under the persistence of the disease.

One of the great drawbacks in the treatment of hip and kindred diseases is, that they scarcely come under the cognizance of surgeons in the commencement, and if they do, they are rarely recognized at their earlier stage.

There cannot be any doubt that the trouble could be effectually subdued in the beginning, and thus all the subsequent mischief obviated. But if effusion into the articular cavity, and structural changes of the component parts have taken place, the treatment not only becomes greatly complicated and protracted, but rarely succeeds in effecting a cure, and scarcely without some impediment to locomotion. Hence your prognosis cannot be guarded enough; for, while the symptoms seem to be mild, and obviously controllable by ordinary means, the process of structural disintegration may have commenced—may go on in spite of your therapeutical efforts—and may, at a future juncture, constitute too formidable a malady to be susceptible to amendment.

In no other disease is a correct diagnosis of greater importance for a circumspect prognosis than in morbus coxarius, and in no other has the introduction of anæsthetics been of more benefit for ascertaining the actual pathological condition than in this.

It is not enough to look at the patient. To ascertain the apparent differences in the length of the extremity, the amount of deformity, and the impediment to locomotion, you must go beyond those symptoms, and investigate the morbid state of the joint; whether there is already roughness or crepitus; whether the movements of the joint are so loose as to allow the inference of the ligamentum teres being already destroyed; whether there is an abscess in process of formation in the neighborhood or opposite the bottom of the acetabulum; or whether the latter has already been broken through by caries, which can be ascertained only by introducing the finger into the anus. If you find an abscess below Poupart's ligament, in conjunction with hip disease, your suspicion is naturally directed to the bottom of the acetabulum, from whence it rises, between the innominate bone and its periosteum, up to the brim of the pelvis. Occasionally the matter penetrates the joint, between the cotyloid ligament and the margin of the acetabulum, and if it concerns the upper segment, the abscess is formed at the same place where we observe the psoas abscess.

So thorough an examination can only be made

by the aid of anæsthetics, not alone for the purpose of obviating pain, mostly excessive in these cases, but to control likewise voluntary muscular contractions obscuring diagnosis.

After you have thus defined the actual state of the joint and its adjacent tissues, you may shape your prognosis accordingly.

Treatment of Deformities arising from Hip-Joint Disease.

Gentlemen, when we entered upon the study of medicine, some twenty-eight years ago, we had the privilege of being instructed by the late Prof. Rust, of Berlin, then at the climax of his European reputation. His clinical lectures were then considered invaluable, and every axiom that dropped from his lips was received as more precious than gold, and was adopted and esteemed as surgical gospel; to dispute it was considered nothing less than the blackest infidelity.

The treatment of hip disease, as approved by Rust, consisted in the administration of antiscrofulous remedies, and in the local application of derivants, among which the actual cautery occupied a prominent place. Although Rust's views as to the pathology of the disease never acquired in England an undisputed sway, yet the treatment adopted by English surgeons did not differ essentially from that of our esteemed surgical perceptor as late as 1853, as we have had opportunity of personally observing. Even at a later period, the celebrated Scotch surgeon Syme extolled the actual cautery as the most beneficial remedy in all chronic affections of joints. A similar treatment prevailed among American surgeons up to that, and even to a later time, and its correctness was so deeply rooted in the professional mind of this country that other therapeutic measures were emphatically pronounced *dangerous innovations, and unsparingly sneered at.* Sir Benjamin Brodie's advice to secure rest in an affected hip-joint by the leather splint, Prof. Bonnet's suggestion of his *grand appareil*, Prof. Alden March's cloth splint impregnated with glue, and the earliest of all suggestions, viz., a straight, wooden splint, advocated by the late Prof. Physick, of Philadelphia, were not heeded by the profession. It is true that these eminent surgeons did not back up their commendation by an exhaustive pathological knowledge of the disease and its collateral symptomatic elements, but the advice *that the affected joint should be kept at rest* was in itself consistent and rational, and should have commanded the attention of practitioners.

For at least fifteen years our interest has been engaged in the investigation of this and kindred diseases, and in spite of our deeply engraven reverence to the incomparable merits of Rust, both as a surgeon and clinical teacher, we were by undeniable facts irresistibly driven to skepticism regarding his specific pathological and therapeutical views. It is but natural that the force of negative facts should have led us to oppose his theory before we were prepared to establish a new basis to act upon. Our first literary attempts in this direction exhibit, therefore, all the imperfections arising from a transition state. But persisting in our inquiries, and accumulating more clinical material every day, we were soon prepared not only to amend our previous errors, but to elaborate and bring forth principles of more rational application.

But we wish to be distinctly understood that we do not look upon hip disease as *an affection of peculiar or exceptional character*, differing in its nature from similar affections of other joints. On the contrary, there is nothing in its cause, development, or termination which renders it a specific pathological process. The differences which it presents are more external and mechanical, and depend more on the form and construction of the articulation than on its structure. Hence the same therapeutical maxims we have advanced in the treatment of other joint diseases find their fullest application in morbus coxarius.

The modifications which we shall mention in the course of this lecture appertain simply to some symptoms and mechanical points which present themselves as collaterals.

The earlier you begin the treatment of inflammatory affections of the hip-joint, the more speedy and more complete will be your success. Being called to attend a little patient that has met with a contusion of or a fall upon the hip, we should at once advise you to look upon such case as a future hip disease, and to take your measures accordingly. For you can do no harm by precautionary measures, and may prevent a formidable affection. Do not mind the leniency of the symptoms for the time being, and remember that, as a general thing, the initiatory symptoms are always insignificant, and utterly uncertain whether they will not become aggravated in time and dangerous in the end.

The first measure that should be taken is *rest*

and *suspension of all locomotion.* The more completely the rest is secured and eventually enforced, the more certain the prevention of subsequent trouble. The duration of rest should be, in accordance to the violence of the accident, from four weeks to three or more months. There is a general aversion to subjecting little patients to what is considered great hardship, and to depriving them of their physical exercise. But we have never had any difficulty in attaining the cordial consent of parents, if they were properly informed of the purpose, and the protection derived therefrom against a formidable malady.

Whether the rest should be combined with extension, local depletion by leeches, cold and other appropriate applications, depends, of course, on the severity of the preceding cause, and should be resorted to unsparingly, if necessary.

You will, however, but rarely be called upon to prevent, by timely measures, the ulterior consequences of traumatic violence. Mostly the patients exhibit already the unmistakable evidences of a progressive effusion in the joint—pain, deformity, and impeded locomotion—when your aid is invited; and sometimes the constitution may already be disturbed by want of rest and appetite.

If the case has not yet passed the second stage, and if the existing symptoms still denote the inflammatory character, with its immediate results, namely, effusion into the articular cavity, hydraulic pressure, eversion of the extremity, etc., the antiphlogistic method is in its proper place. But what is more calculated to arrest inflammation than the *most absolute rest of the implicated articulation?*

In this stage *it is not enough to suspend locomotion* and *consign the patient to the recumbent posture;* we must likewise provide a *proper position of the affected extremity.* We have had considerable difficulty in devising mechanical means to accomplish the stated object. In succession we have vainly tried the proposed splints of Physick, Brodie, and Alden March. The "*grand appareil*" of Bonnet we have never seen or applied, believing it inefficient, and too costly for general use. Dzondi-Hagedorn's fracture apparatus suggested itself as apparently superior to all; but in its practical application it failed to fix the pelvis, being conditional upon absolute rest of the affected extremity, though useful for extension.

After many failures we succeeded at last in constructing an apparatus of wire which combines all the advantages of Hagedorn's splint, with others of which the latter is deficient.

1. It secures a permanent position of the pelvis and both lower extremities.

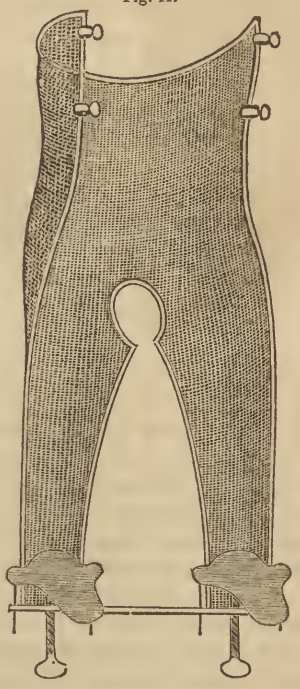
2. It allows extension and counter-extension.

3. It enables the patient to evacuate his bowels without disturbing his position and extension.

4. It permits the patient to be moved about and to be taken into the open air without prejudicing the progress of the treatment.

Such an apparatus you have now before you, Fig. 41. It consists, you perceive, of a frame of stout

Fig. 41.



and tin-galvanized iron wire, being filled with wire webbing soldered to the frame. There is a proportionate opening in the apparatus for the anus. At the foot extremity a cross-bar of iron is affixed, through which screws and small bars pass to move the foot-boards. The extension is made by the latter; the counter-extension is placed at the tubera ischii, and is partly made through the healthy extremity, which is fastened down by bandages as in Hagedorn's contrivance. The apparatus, when applied, looks like the posterior half of a pair of pants, and has therefore been named by a waggish friend, "wire breeches." The whole is nothing more than an *improved*

apparatus of Dzondi-Hagedorn, made of different material, having no similitude to the "grand appareil" of Bonnet, as Barwell and others have surmised. We shall now show you how to apply it, Fig. 42.

Fig. 42.

1st. Fill the apparatus with tow, so as to render the patient comfortable and to protect him against pressure. Look particularly after the proper protection of the heels by propping tow alongside of the Achillis tendon. 2d. Apply on either side of the affected extremity a strip of stout adhesive plaster, almost up to the hip-joint and long enough below to allow its being bound to a bow. Fasten it to the extremity by either circular strips or a roller.

Thus prepared, the patient is placed in the apparatus, the healthy extremity first secured by a strong roller, particularly tight around the knee-joint to prevent its being bent and to loose thereby the counter-extension. We should have stated before that cotton should not be used as bolstering material if tow can be had, for it is very heating, becomes matted, and possesses less elasticity than the latter. If the affected limb is much flexed, and its extension painful, anæsthesia should be resorted to. The longitudinal strips are then fastened to the foot-board, the extension carried as far as desirable, and at last the extremity bandaged to the apparatus. In restless individuals it may be prudent to restrain likewise the freedom of the trunk by a wide belt. The mechanical treatment may be advantageously combined with and supported by repeated local depletion, the inunction with ungt. hydrargyri and appropriate internal remedies; but absolute rest occupies the most prominent place among them. In incipient cases of morb. coxarius we never failed in benefiting our patients. The excessive pain and symptomatic fever become alleviated and sometimes arrested as by a charm; the patients regain sleep and appetite, and at once evince signs of general improvement, and, what is equally important, *you prevent deformities and malposition.* How long the patient should remain in this rather confined position depends of course on the intensity of the symptoms. Four weeks may be sufficient in one instance, and four months may be needed in another; at any rate, the patient should not be taken out of the apparatus unless the inflammatory symptoms have subsided.

The apprehension that a longer confinement of this kind must prejudicially act upon the general constitutional status is certainly exaggerated; at any rate, it is *the lesser of two evils*, and may be rendered more endurable by taking the patient into the open air.

Of late the pulley has been substituted for the wire apparatus, and in as far as extension and cheapness goes, it is certainly preferable; but in regard to rest of the joint, the pulley is inefficient.

The after-treatment should be carried on for some time by Davis's, Sayre's, or Vedder's splints, of which we shall speak hereafter more minutely.

Supposing, however, the case is more advanced, the articulation completely filled with inflammatory products, some of the muscles already contracted, the pain proportionately very intense, the limb and the whole body attenuated from the violence of reflex symptoms, our plan has to suffer some modification.

We have, first, to relieve the tension of the capsular membrane. This can be done in various ways:

1. By bursting the joint, to be effected by giving the extremity a diametrically opposite position from that it occupies.

2. By subcutaneous paracentesis, with either a trocar or tenotome.

As to the technical proceeding of these operations, we refer you to our lectures on "hip disease," in which they are detailed.

The therapeutical virtue of these operations is great. With the tension of the joint it obliterates the source of almost all the local, and of some of the reflex symptoms, and the relief derived therefrom is consequently material. So it has proved in our hands; and Richard Barwell, Esq., the able surgeon of Charing Cross Hospital, who has lately given his special attention to the subject, speaks of it in terms of the highest commendation.* Moreover, in relieving the joint from its morbid contents, no danger is engendered, and we do only what nature will do spontaneously at a later period.

Your attention should be next devoted to the reflex symptoms, for they are not only productive of intense suffering, but they disturb incessantly the rest of the joint, and therefore keep up inflammation, and inflict more injury on the system than the disease itself. Do not expect to mitigate that frightful "nocturnal pain," and the "convulsive muscular quiver," by anodynes; they have very little effect in large, and none in small doses. Morphia alone has scarcely ever reached the reflex symptoms, but a combination with belladonna in the following formula has sometimes benefited our patients:—

℞.—Extracti belladonnæ, gr. ij;
Morphiæ acetatis, gr. vi;
Acidi acetici, gtt. viij;
Aquæ laurocerasi, f℥ss.
M. da signa.
From eight to fifteen drops at bedtime.

But, gentlemen, you cannot rely on this, or any other anodyne, though they may afford temporary relief. You have to resort to absolute rest of the joint and powerful extension.

Some surgeons have expressed their belief that extension took away the pressure from one articular surface upon the other. This is certainly an erroneous view, in so far as the hip-joint is concerned, for reasons already stated on a former occasion. Extension acts mainly upon the muscles, preventing their morbid contraction, and this is the whole secret of its therapeutical efficacy.

If the disease has not gone too far, and muscles are not already and permanently contracted, these remedies will gradually subdue the disease, when the general health will proportionately improve. After some months of persistent treatment in this direction, the patient may change the wire apparatus for a splint, and carefully resume locomotion with the aid of crutches.

If, however, the muscles have already contracted, extension is not only *ineffective*, but even *dangerous*, and should be *preceded by the division of the contracted muscles. Extension can prevent, but not cure active contractions of muscles, and its indiscreet application will certainly stimulate the disease.*

Gentlemen, absolute rest of inflamed joints however beneficial for a time, has likewise *its therapeutical restriction.* Daily experience teaches that if the immobility of healthy articulations is unduly prolonged, they will become *stiff, dry,* and *even anchylosed by fibrous bands.* How much more may this be expected in joints *filled with organizable material!* Indeed, we have observed cases in which anchylosis ensued after a comparatively short repose of the articulation. These inconveniences, incidental to continued rest, with the confinement of the patients, have often been subjects of discussion with professional friends. Professor Sayre more especially suggested the propriety of such improvements of the needful mechanical appliances as to enable the patient to walk during the greater part of the treatment. Although we directed our combined efforts upon that point, yet we had achieved nothing practical, when Dr. Sayre incidentally heard of Davis's splint. He lost no time in rendering himself familiar with its construction and practical working.

Having become satisfied that, with some improvements, this splint would realize all the

* A Treatise on Diseases of the Joints. London, John Churchill, 1861.

objects we had conjointly determined on, Dr. Sayre had the goodness to place it at our disposal for additional clinical observation. It is, therefore, but plain justice to him in acknowledging the fact *that, through his instrumentality*, Davis's splint became, in an improved form, accessible to the profession. In our humble opinion, the charge of plagiarism against Dr. Sayre is groundless and unjust. But for *his* intrepidity and surgical sagacity, Davis's splint would not modest to put it in so bold relief as to render it generally known. But then he should be glad that Dr. Sayre assisted in the publicity of his splint, and brought its merits more prominently before the profession.

We are not aware that Dr. Sayre has ever laid personal claims to originality of the splint, but exclusively and justly demanded the merits of improvements, which indeed are of mechanical advantage. Moreover, it has been the avowed

Fig. 43.

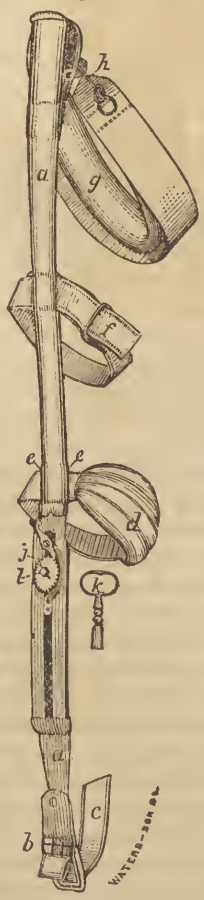


Fig. 44.

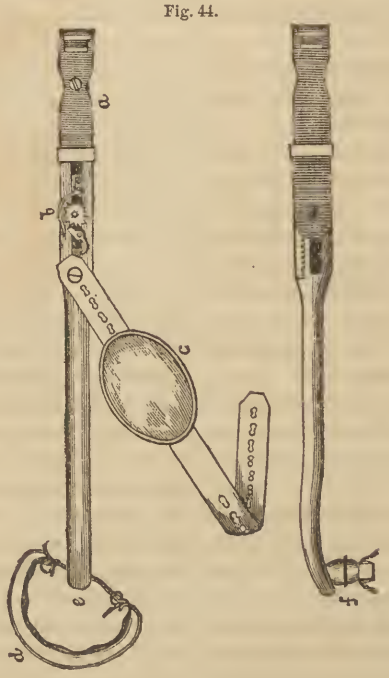
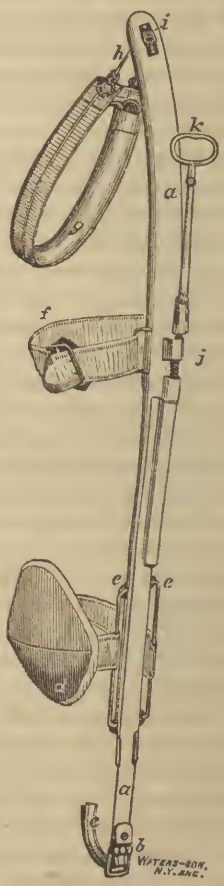


Fig. 45.



be known; and he is, therefore, much more entitled to consideration than Dr. Davis himself, who, according to his own admissions before the New York Academy of Medicine, *had the apparatus in use for more than eight years without giving it to the profession.*

Perhaps Dr. Davis did not fully realize the importance of his contrivance, and was too policy of the profession to discountenance monopoly in all matters of medical science and the healing art whatsoever; and *since Dr. Davis has omitted to put his invention on record, he should, in compliance with that policy, not complain if another has taken the initiative.* Nevertheless, the profession has been willing to acknowledge the merits of Dr. Davis; and if we could add to

the just appreciation of the splint, we would cheerfully state that it forms a most needed, useful, and efficacious remedy in the treatment of hip disease. With so general a professional approval, Dr. Davis should be contented, and all bickering should be dropped. Otherwise, it might be urged that Dr. Davis has not promulgated the principle of extension in joint diseases; and if so, he has certainly failed to establish his authorship beyond dispute, and again, that his splint is a remarkable copy of Jarvis's adjuster, which may have served as prototype.

However useful and indispensable the hip splint obviously is, its application in hip disease is nevertheless strictly circumscribed. In the active stage of that malady, while the symptoms of inflammation supervene, absolute rest of the joint and extension are the exclusive and rational remedies. Whether our wire apparatus or the pulley and weight be resorted to, is indifferent as long as the object is accomplished.

Again, if the reflex contraction of muscles appertaining to the hip-joint has become permanent, subcutaneous division of the contracted muscles should PRECEDE *extension*, by whatever means it may be carried out. Whereas the splint comes opportunely in for its share—

1. In incipient hip disease when the inflammation and reflex actions are moderate.

2. After the active symptoms have subsided.

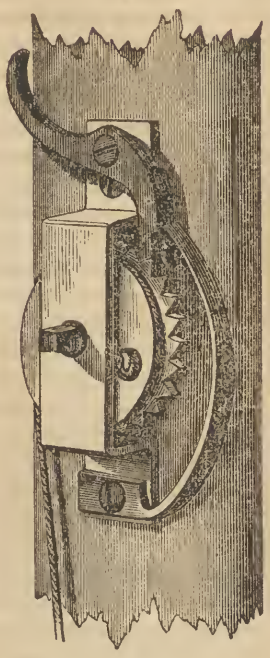
3. After the contracted muscles have been successfully divided.

It is scarcely necessary to qualify our advice, or to repeat on this occasion the principles which guide the maxims of our treatment, in as much as this has been done in connection with the same subject elsewhere.

We are sorry not to be able to place before you all the modifications of Davis's splint, or the new contrivances to which it has given rise. There are now three of these splints in general use. The original splint of Davis is certainly the least perfect, in as much as the degree of extension cannot be regulated. With his latest improvements we are not acquainted. The improvement of Dr. Sayre allows the finest graduation of extension, and is, in a mechanical point of view, a more perfect construction, Figs. 43, 44, 45. Dr. Vedder's splint is very light, exceedingly simple, highly effective, and cheaper than the others; hence more commendable for the poor (Fig. 46) for extension.

In resorting to the splint, the same maxims are to be observed as for the use of mechanical

Fig. 46.



apparatus in general—that is to say, the instrument should *fit well*, should be *well applied*, and kept in *a state of effectiveness*. If circumstances render its discontinuance necessary, it should be immediately exchanged with the pulley and weight. The application of the splint is *essentially* the same in each. A strip of strong adhesive plaster, with a loop at its lower end, is fastened along and outside of the affected extremity, and should above almost reach the hip-joint, being fastened either by circular strips or a roller. Next the pelvic band is applied, and care must be taken that it is of proper length; at last the lower end of the adhesive strap is fastened to the splint. It will be observed that in turning the wheel the limb is extended, whereas the pelvis is drawn upward; its effect being to keep the limb straight, and to prevent the contraction of muscles. In the diagram you observe the application of the instrument, together with a knee-cap and a thigh-band, Fig. 47. If the limb be already slightly contracted, it may be advisable to place the patient under chloroform while the extension is being made. The usual effect which the splint

Fig. 47.

exercises on the condition of the patient, is the alleviation of pain, and thereby rendering him capable of moderate and cautious locomotion. Should the pain materially increase, and the patient become restless and feverish, it would tend to prove that the contraction of muscles has proceeded too far for simple extension, and that the splint rather irritates than benefits. Under such circumstances, we hold the subcutaneous division of the contracted muscles unavoidable. To persist in extension, would be to aggravate the disease. Care should likewise be taken that the pelvic band does not chafe the integuments. In order to relieve the parts from pressure, and to render the patient more comfortable during the night, it may be desirable to remove the splint, and to effect extension by pulley and weight in the horizontal position. If you place the patient upon a water-bed, you will greatly add to his comfort.

The usefulness of the splint is not precluded by an abscess, unless its seat and the tenderness of the parts render the former inapplicable. Dr. Sayre and myself have employed the splint with advantage in large openings of the hip-joint, and the preceding figure is taken from a child thus successfully treated by him. In comparing Fig. 38 with Fig. 47, the result may be observed, having been chiefly wrought, however, by dividing all the contracted muscles.

Thus the hip splint has of late found a most extensive field of useful application; and it has, more than anything else, practically demonstrated the inefficiency of former curative maxims. In fact, it has completely revolutionized the accepted pathology of the disease. Those who attended the late discussion of the New York Academy of Medicine, on hip disease, cannot have failed to notice the conversion of most surgeons to modern views. Yet with some of them a strange inconsistency still prevails. They hold that hip disease is the result of the strumous diathesis; that tubercular deposit in the cancellated structure is the proximate cause, yet they admit the usefulness of hip splint in controlling the malady, and the occasional necessity of myotomy in amending the deformity. None of them, however, attempted to reconcile the cause with the effects of the remedies. That a tubercular disease cannot be restrained by a splint, extension, or by dividing a muscle or two, is self-evident, and that a constitutional disease is equally unamenable to mechanical remedies, needs no proof. If the maxim be right that the action of remedies tends to illustrate diagnosis, why not apply it in this instance? Such are, however, the inconsistencies that facts, however stubborn, have to accommodate themselves to preconceived opinions, though speculative in character. The march of truth, however, is necessarily protracted, and we must rest contented with small advances. Already much has been gained by throwing out the favorite fiction of spontaneous dislocation; and less has of late been said about the issue, moxa, and actual cautery. We may yet live to see the time that our surgical excellencies smile at the very idea of such a thing as a tubercular bone disease.

The muscles most usually contracted in hip disease are the adductors and flexors of the thigh; the deformity caused by their joint contraction is therefore undue adduction and flexion. It is not often that the pectinæus and the biceps femoris are included. The division of those muscles is subject to the same general rules we have endeavored to establish elsewhere. It is of importance to stretch them, under the influence of chloroform, to the utmost of their capacity, so as to raise them off the sub- and adjacent parts to use their contours as a guide, and to insure their total division. The operation in the neighborhood of important vessels and nerves seems to be rather dangerous; but in observing the foregoing precautions we have never met with any difficulty, although frequently performed.

The adductor muscles, the tensor vaginæ femoris, and sartorius muscle we prefer dividing from outside inward, whereas the rectus muscle we divide from within to without by pushing Bouvier's blunt-pointed tenotome under its internal margin. In order to obviate collision with the vessels and nerves of the femoral canal, it is advisable to rotate the limb externally, which increases the distance within the two structures.

Since the tenotome has to perforate the vagina femoris, the greatest care should be taken to prevent a collection of blood below, as it occa-

sionally gives rise to abscess under the fascia. Thorough squeezing out of the blood will generally suffice as a preventive measure; the fascial wound may also be dilated.

The anchylosis of the hip-joint may be an object of treatment, when combined with deformity. A true bony anchylosis is comparatively as rare at the hip-joint as at other joints. The only remedy for the impediment lays with Rhea Barton's operation. Whether it should be combined with division of muscles, the special case must suggest for itself.

Most anchyloses of the hip-joint are, however, by fibrous connections and by thin osteophytes. This nature of the impediment may be surmised, when periostitis, rheumatic synovitis, or a moderate inflammation of the articular apparatus has supervened and no cicatrices with deep connections exist in the neighborhood.

The brisément forcé may then be resorted to with or without division of muscles to re-establish both form and mobility. It is, however, not advisable to attempt this operation before the completion of puberty, for fear of causing a diastasis of the femoral head from the diaphysis. It is likewise desirable to continue about a week with the division of the contracted muscles, and allow the wounds to heal completely before the connection of the joint should be broken up.

If we do not mistake, the late Dr. Buehring, of Berlin, was the first who performed successfully the brisément forcé upon the hip-joint, and he constructed a very ingenious apparatus to give free mobility to the joint. Professor B. Langenbeck followed in the enterprise, and modified Buehring's apparatus. Since, other surgeons have performed the operation with most brilliant success, and but lately, Professor Sayre treated such a case in a gentleman, with the most satisfactory result. You remember Figs. 39 and 40, exhibited at our last lecture. The right thigh of the patient was rectangularly fixed to the pelvis, and the limb thereby shortened some seven or eight inches. After a treatment of but few weeks the results obtained may be realized by a diagram, Fig. 48. You notice the limb to be straight, almost of the same length, and, what cannot be seen, the mobility of the joint was established almost to perfection. Such are the wonderful achievments of modern surgery, for which we are chiefly indebted to Louvrier.

It may be well to state, that Dr. Sayre employed no other implement in the operation than the hand. In performing brisément forcé upon the hip-joint, the patient should be placed upon a firm mattress, and, after having been brought under the influence of chloroform, his pelvis should be powerfully fixed by an assistant, the mobility of the thigh started by a sudden flexion followed by extension and rotation.

Fig. 48.

We have just received the third number of the second volume of the "Archiv of Clinical Surgery," published by Professors B. Langenbeck, Billroth, and Dr. Gurlt, in which an article of Dr. Richard Volkmann attracts our particular attention. Being of great importance for the correct diagnosis of the deformities appertaining to the hip, the apparent and real length and malposition of the lower extremities, we thought it desirable to call the attention of the reader to Volkmann's new measuring instruments, which he terms "Coxankylometer." It consists in a horizontal, moderately convex spring of hammered brass, seventeen inches in length, to adapt itself to the lower region of the abdomen. With this spring a flat, thin, or narrow piece of wood, 30″ in length, is rectangularly fixed so as to constitute the form of a T. By placing the patient in a horizontal posture upon a hard mattress and the pelvis in the proper relation to the spine; by fixing the instrument in front of the body immediately above the anterior superior spines of the ilium, with the wooden bar downward, the author is able to measure the exact angular deviation of the extremity from the perpendicular of the body and self-evidently the apparent deviation of their length from the normal standard. The instrument of Volkmann substitutes a more reliable mode of measurement over the existing ones, and commands, therefore, the attention of surgeons. But it should be borne in mind that the deviation caused by the increased inclination of the pelvis cannot be ascertained by the same. We feel not at liberty to give this subject a more

extended notice, and must refer you to the original, which is well worth your perusal.

IV.—*Deformities of the Spine.*

Gentlemen, the spinal column is, both in an anatomical and mechanical point of view, a wonderful construction. In adults it consists of twenty-four single bones (vertebræ) united in a continuous column by twenty-three intervertebral fibro-cartilages. These endow the spine with a high degree of flexibility, constrained, however, by the shape of the vertebræ and their strong ligamentous apparatus. The intervertebral disks, being very elastic and increasing in thickness toward the base of the spinal column, are eminently qualified to break the violence of mechanical influences. In this the cartilages are greatly aided by the natural curves which the spine of a full-grown man presents. Prof. Weber* has most accurately ascertained the physiological deviation of the spine from the perpendicular. After having prepared the subjects by removing the thoracic and abdominal organs, and filling the cavities with a solution of plaster of Paris, he divided the spinal column with the plaster mould longitudinally, and by this process preserved its correct position. The result of the measurement may be briefly stated as follows: Atlas and centre of sacro-vertebral articulation conform with the perpendicular. The centres of the second and third cervical and fourth and fifth lumbar vertebræ slightly project from the perpendicular, whereas the rest recede. The greatest tension of the curve lies at the sixth and seventh thoracic vertebræ, whose distance from the perpendicular amounts to 2·750″. The first and last thoracic vertebræ occupy the same position to the perpendicular—namely, 1·400″. From these researches it is obvious that when viewed in the profile, the spinal column presents three curves —two small ones anteriorly at its cervical and lumbar portion and a large posterior one. Rollin and Magendie have asserted that the threefold curves of the spine increased its mechanical strength sixteen times. But this is certainly an error, and against all mechanical laws. On the contrary, the curves obviously weaken its physical strength, and the most powerful musculature is necessary to sustain its firmness in the erect posture. The curves, on the other hand, render the spine more endurable to violence that may bear upon it from above or by contre-coup, which would certainly crush a straight one. Besides, space is thus provided for the suspension and protection of vital organs. The oval form of the vertebral bodies subserve the same mechanical purposes as the round form, yet leave more space in front and behind. The cancellated structure is likewise better adapted to the vertebral bodies, being lighter and less frail than the compact osseous substance, though the latter would bear more weight.

E. H. Weber* has acquainted us with the relative part the vertebræ or cartilages have in the formation of the spinal curves.

The subjoined table exhibits the proportionate thickness of either. The first column states the number of the vertebra and inververtebral cartilage; the second, the middle size of the vertebra; the third, middle thickness of the cartilage; the fourth, the difference between the anterior and posterior height of the vertebra; the fifth, the same difference of the intervertebral cartilages; the sixth, in fine, the middle diameter of the latter. The + and — indicate excess and deficiency.

1		2	3	4	5	6
Cervical.	1	0·00	0·00	0·0	0·0	0·0
	2	31·50	2·70	+3·0	+0·6	14·7
	3	13·20	3·55	+0·8	+0·1	14·9
	4	13·05	2·65	—0·1	+1·3	14·2
	5	13·10	3·75	—0·6	+1·5	15·1
	6	12·00	4·60	—1·0	+1·2	15·9
	7	13·00	3·45	—0·8	+0·1	15·2
		95·85	20·70	+1·3	+7·8	
Dorsal.	1	16·80		—1·0	+0·8	17.0
	2	18·60	3·40			19·8
	3	18·50	3·15	—0·0	—1·3	21·3
	4	19·20	2·40	—2·0	—1·2	21·9
	5	19·85	1·90	—1·9	—1·8	26·4
	6	19·40	2·15	—2·0	—0·7	27·5
	7	19·50	3·10	—2·4	—1·4	28 5
	8	20·45	3·15	—1·5	—1·3	27·8
	9	20·45	4·30	+0·3	—1·2	28·0
	10	23·20	3·20	—0·6	—1·2	28·8
	11	23·20	2·50	—1·4	—0·6	
	12	23·80	5·65	—1·0	+0·7	
		242·95	34·90	—13·3		
Lumbar.	1	26·50	4·70		+2·0	27·9
	2	28·15	4·85	—0·8	+2·1	29·1
	3	28·15	6·90	—1·1		29·1
	4	26·75	6·85	+0·7	+2·2	29·3
	5	26·30	8·65	+1·7	+3·3	29·5
				+6·2	+2·3	27·7
			10·90		+9·2	
		135·95	42·85	+6·7	+21·1	

* Mechanic der Menschlichen Gehwerkzeuge. Göttingen, 1836.

* Merkel's Archiv, 1827.

In comparing the results of the fourth and fifth columns, we find that at no part of the spine are the anterior and posterior height of the vertebral or intervertebral cartilages the same, and that the difference in their thickness is the cause of the respective curves. It is also evident that the cervical and lumbar curves are chiefly formed by the cartilages, whereas the thoracic curve depends mainly on the form of the respective vertebræ themselves.

Although the elasticity of the intervertebral cartilages is great, yet it does not entirely accord with the elasticity of unorganized substances. Thus for instance, the cartilages do not possess the power to resume their full height after compression. Hence the body, in the erect posture, loses about one inch in the course of one day, and requires the horizontal posture for six to eight hours to regain its full height.

This physical condition of the intervertebral substance is no doubt operative in the establishment of distortion of the spine.

In the preceding remarks, we have dealt with the spine of adults; but its anatomico-mechanical structure in infants and children differs widely from that of adults. The ossification of the spine in the embryo appears later than in almost any other bone of the skeleton; the anatomical perfection requires likewise more time, and exceeds the period of puberty by years. During all that time some parts of the vertebræ are connected with the bodies by cartilages, and, consequently, they are much more easily disconnected by traumatic causes than if the vertebræ were entire. This anatomical status renders the spine as a whole much more flexible than that of adults. In fine, there are *no physiological curves in the spine of infants*, and they develop themselves very slowly, so that they are scarcely established to their full extent at puberty. This should be borne in mind, because it accounts for the greater susceptibility to spinal deformities in childhood.

To all appearance the spine is a mechanical apparatus of great physical strength, and certainly well calculated to fulfill the offices which nature has designed for it. By constant physical training, its mobility may not only be increased, but greatly extended beyond the ordinary anatomical limits, which can be observed in the feats of gymnasts. Not every spine can bear, however, such distortions without injury, and it would seem that they are much more easily produced than has been hitherto supposed. The experiments of the late Professor Bonnet, of Lyons, render this almost conclusive. He succeeded in producing upon the spine and its components, with comparative little physical violence, any injury, from the rupture of ligaments and muscles to dislocation and fracture of the vertebræ. In the spine of children this would be much more easy than in adults, to which the experiments of Bonnet seemed to have been restricted. Nor can there be any doubt that fractures of the spine occur more frequently during life than is generally believed, for the Museum of the Royal College of Surgeons, England, the Musée Dupuytren, and other private collections, contain specimens to that effect. In some of them the diagnosis was made ten or more years after the accident, and in some post mortem.*

Posterior Curvature of the Spine (Kyphosis Gibbus.)

This deformity was not only known by Hippocrates, but its cause was definitely attributed to tubercle "within and without the lungs." Galen employed the same term. Guillot and Nélaton are of the opinion that the pathological knowledge of tuberculosis can be distinctly traced to the ancients. However this may be, it is equally correct that Marcus Aurelius Severin introduced the term "tubercle" in the seventeenth century, with a rather loose meaning, and Delpech gave to it its present pathological currency.

The authors who, during the seventeenth and eighteenth centuries, investigated the pathology of kyphosis, as Bonnet, Ruysh, Cooper, Pott, promulgated the idea that caries of the spine was the invariable cause of the malady, and Delpech gave it the finishing touch, in demonstrating that the caries originated in tubercular disease. This opinion met with a general acceptance, and with some surgeons it prevails to this day. In Nichet and Nélaton it found its warmest advocates.

Delpech lays down two modes of tubercular invasion. There is either a central deposit which grows by juxtaposition, gradually rarifying and destroying the cancellated structure of the vertebral body, until it is physically disqualified to bear the superincumbent weight. It breaks consequently down and suddenly gives rise to a posterior curvature of the spine. Or the tuber-

* Beiträge zur vergleichen den Anatomie der Gelenkkrankheiten van Dr. Gurlt. Berlin, 1853.

cular material is deposited in front or by the side of the bodies, and gradually excavates them, until the destruction of the bone has been accomplished to the opposite wall, when the spine breaks down, and bends either posteriorly or laterally, as the case may be.

Nichet and Nélaton advert to a third mode, namely, *a general diffusion or infiltration of tubercular substance throughout the entire cancellated structure*, with subsequent absorption of the latter or the formation of a sequestrum. The intervertebral disks are but exceptional recipients of tubercular deposits. (Nichet.)

Between the views of Pott on one side, and those of Delpech, Nichet, and Nélaton on the other, there is no difference. One stands to the other in the relation as cause to effect. Kyphosis, or Pott's disease, as it is likewise called, is consequently a posterior, mostly angular curvature, initiated by tuberculosis of the spinal bodies, followed by carious destruction of their cancellated structure, the deformity being but a symptom.

With very few exceptions the foregoing opinions seem to have been adopted without question or dispute by all modern writers. It appears almost presumptuous to entertain doubts where the most positive assertions are made by surgeons of the highest repute and competency. It is but natural that we approach the subject with some timidity, yet, under the force of facts, we venture upon the criticism as an imperative necessity for the establishment of pathological truth.

Bonnet states that, however great the merits of the researches of Nichet and Nélaton on this particular subject unquestionably were, they had certainly been received with too great readiness and too little reservation. They had so much preoccupied the minds of their contemporaries as to exclude other observations equally reliable. He, for one, knew positively that other causes than tubercular deposits were prone to establish kyphosis. More recent investigations of tuberculosis have wrought very different results. The existing confidence in the prevailing views of the proximate cause and nature of tubercular matter has been seriously shaken. A complete revolution is threatened in this branch of pathology, which seemed to have been settled once forever.

First, we wish to call attention to some experiments of Cruveilhier,* seemingly the only ones bearing upon the question. He injected quicksilver into the air-passages of animals. In examining the pathological results at different stages, he elicited the following facts. An exceedingly small globule of the metal occupied an air-cell imbedded in fluid pus. At a later period this pus was semi-fluid, then of cheesy consistence, and, in fine, hard. At last it became semi-translucent.

These experiments clearly demonstrate the gradual changes which ordinary purulent matter may undergo by absorption of its liquid component. Both Rokitansky and Gurlt state, in addition, that pus may even undergo the process of calcariazation. In this respect, therefore, tubercular matter presents no marked difference from pus. Moreover, we can adduce unexceptionable pathological authorities (Reinhardt† and Lebert‡) that in numerous instances of pronounced tubercular deposits in bones, the microscope revealed fat and other granules, pus corpuscles and bone detritus. In some specimens Lebert found so large corpuscles that he felt unable to decide whether they were tubercles or pus. If the microscope was insufficient to determine the nature of the material, it is very evident that the naked eye is still more so. Lebert's investigations, it should be borne in mind, were carried on at a time when our knowledge of pyogenesis was embryonic; when we were as yet unacquainted with cellular bodies in the connective tissue; when we were ignorant of the fact that the formation of pus was in part only by the division of corpuscles, but in the greater part by endogenesis, as in soft cancer, by the generation and bursting of parental pus cells. It is, therefore, not unlikely, at any rate not impossible, that the large cells which Lebert was unable to determine, were the identical parental cells of pus.

In still more recent investigations by Gurlt, Bilroth, and especially by Virchow, the facts have become established in such number as to render the existence of tuberculosis almost problematical. Virchow emphatically asserts that he has never seen the *so-called tubercular cell*, and that *in the material hitherto pronounced tubercular, he has failed to recognize anything*

* Traité d'Anatom. pathol. générale. 2 vols. Paris, 1849-52.
† Annalen des Charité-Krankenh. Berlin.
‡ Malad. scroful. et tuberc.

specific outside of the casual results of the inflammatory process. In as far as the bone tubercles are concerned, the very thorough and diligent researches of Gurlt render them entirely mythical. The favorable opportunities which that inquirer enjoyed in observing the inflammatory process of bones, in both men and domestic animals, leave not a shadow of doubt that the pathological changes are anything but tubercles. *The grayish substance* with which we find the bones invaded is a soft, fatty material consisting of an exuberance of connective tissue and fat globules, with or without pus corpuscles, evidently the result of endostitis; of which the attributes are presented in the surrounding bony tissue. Of this pathological condition we have had some specimens in our hands. Next, *a purulent infiltration* of the cancellated tissue may be found; and, in fine, there is *the bone abscess*, both in the vertebral bodies and elsewhere. Of the latter, Gurlt has given us a most graphic description. If the matter collects in a circumscribed cavity of the bone, the osseous tissue forming the wall of the abscess becomes denser, a condition which has been termed sclerosis, and which is identical with the eburnated structure of John Tomes. A fine lining membrane may also be discerned. The pus contained in the abscesses is mostly of a pultaceous consistence, and sometimes concentric striata may be observed, being drier and harder toward the periphery and softer toward the centre. Gurlt is of the opinion that the change in the consistence of the pus is induced by the absorption of its serum, and the centre being the farthest from the lining membrane, remains soft for a longer period.

The numerous specimens bearing upon this point may be studied in his work on articular diseases, with great advantage.

This brief review of the subject, if it has failed to convince you of the fallacy of bone tubercle, will at least have taught you that the terms scrofulous or tubercular are too loosely and indiscriminately applied. We are aware that it is a hard task to eradicate the cherished doctrines of our preceptors. Nor may it be convenient to dispense with terms which are so serviceable in covering our pathological and therapeutic shortcomings. But the march of science should not be rendered dependent on notions, nor opposed on account of a veneration for our first instructors.

In disputing the existence of tubercular disease of the spine, we do not wish to be understood as disputing also the occurrence of caries of the spine. We only deny the tubercular cause of caries.

Admitting even for the sake of argument the existence of bone tubercle, we are still at a loss to accord them with most clinical facts. The theory of Delpech, Nichet, and Nélaton may be acceptable for some cases of posterior deformity which eventuate in lumbar and psoas abscesses, and in which the elimination of a tubercular detritus may be supposed. But in the larger number of instances we come in conflict with the established hypothesis, where no consecutive abscesses are formed, and in others where caries and consecutive abscesses exist without deformity. Delpech and Nélaton distinctly state that the tubercular mass encroaches upon the cancellated structure, and thereby destroys the form of the vertebral bodies. There is but one alternative, either the tubercular substance becomes encysted, and gradually undergoes calcariazation, or it softens down, and is eliminated as a foreign substance. In the former supposition we are unable to conceive a change in the form of the vertebræ; in the other, caries and consecutive abscesses are inevitable. This leaves us a large number of cases unaccounted for, which present all the variations of kyphosis, in both form and seat.

It seems, indeed, unnecessary to resort to hypothetical means in order to understand the pathology of the malady. The vertebral bodies are like the cancellated structure in general, highly vascular, and therefore susceptible to inflammation. This process in the bones, and its pathological results are at present well understood. There is not one solitary symptom or morbid change connected with the so-called Pott's disease that could not be brought in accordance with ostitis and its phases. Thus, for instance, a vertebral body may be softened down by inflammatory effusion or fatty metamorphosis, may change its form through the superincumbent weight, give rise to a gibbus, of greater or less size, and then the disease may be arrested without proceeding to the formation of an abscess; or purulent infiltration and caries may ensue. These pathological views would bring it at once within the scope of our comprehension why contusions and kindred injuries of the spine in the healthiest children gradually give rise to posterior curvatures, for which we have analogy in other spongy bones.

But, at best, to spondylitis the smaller fraction of cases can be ascribed. Rickets, periostitis of the spine, and fractures of a limited extent come in for their share. Hitherto, careful pathological records both of the spine and spinal cord are rather scanty, particularly if not suspected of disease. The technical difficulties entailed in the examination of that portion of the body no doubt account for the evident neglect. And yet, withal, a considerable number of observations of fractures of the spine have been recorded that were never diagnosed during life. We have observed one case, which, but for the indiscretion of the parents, might have come under the same category. A weakly child, about four years old, fell upon her back on the sidewalk. We saw her about half an hour after the accident, and noticed that the spinous process of the fifth thoracic vertebra was slightly projecting, and tilting upward. There was then little pain attending the deformity. We were under the impression that the displacement of the bone was dependent upon the fall, and that a moderate fracture of the fifth thoracic vertebra caused the deformity. The parents most strenuously opposed the idea, the mother asserting that the projection of the spine was, to her certain knowledge, an old affair. Nor had the fall been violent enough to justify the rendered opinion. We insisted, however, on the correctness of our diagnosis, and ordered the child to be put on the back for at least three months. The inconvenience, soreness, and pain, which the patient had subsequently complained of, entirely disappeared, and, with the ease derived, the desire for locomotion returned. The supine posture could not be maintained longer than four weeks, and even during that time the patient was frequently sitting up. The parents objecting to further physical restraint, the child began to walk two months sooner than we advised. In about six weeks from that time we were again invited to see the patient, and found her suffering from intense pain in the affected part of the spine, laborious breathing, and fever. The curvature had evidently increased, the fourth and sixth thoracic vertebræ participating. The collateral symptoms indicating the formation of an abscess, we held out but little hope of recovery. In a few hours pleuritis of the left side commenced, and was rapidly followed by empyema, almost filling the cavity, displacing heart and lungs. On the fourth day the patient died, and the post mortem was granted simply for the purpose of defeating our diagnosis. The appearances fully affirmed the views we had taken of the case. *There was a fracture of very little extent of the fifth thoracic vertebra.* A wedge-shaped fragment was chipped off the anterior and inferior portion of the body, with its base connected with the next intervertebral cartilage below. The piece was still covered in part by the anterior ligament of the spine. There was evidently a sliding of the vertebra upon its lower cartilage, which thus caused the spinous process to project and tilt. At the seat of fracture there was an abscess consisting in two compartments on either side, communicating with each other through the fracture. The left one had opened in the left pleural cavity, and had given rise to the pleuritis.

The fracture was so insignificant, and so located, that it might have united without trouble, had sufficient time and rest been allowed. The deformity could scarcely have been obviated, being the direct and inevitable consequence of the physical derangement of the spine. Even a moderate increase of the original deformity would not have been inconsistent with the healing process of the spine, by the necessary softening of the vertebra and its adjacent cartilages.

This case clearly demonstrates how susceptible to injuries the spine actually is, and it seems to corroborate the experimentative results of Bonnet. No doubt can be entertained as to the greater frequency of similar injuries, but they are rarely subject to so early a clinical examination as in the instance related.

In order to ascertain whether the vertebra, changed in the form of its body either by caries or fracture, occupies the most prominent position in the posterior curvature, Bonnet has instituted some instructive experiments, by sawing out of the body differently shaped pieces and subsequently breaking down the spine. The results thus obtained led to the conclusions :—

1. That the injured vertebra invariably presented the greatest prominence in the deformity.

2. That the deformity thus artificially produced was constantly of an angular shape.

3. That it required a far greater wedge to establish the curvature at the lumbar than at the thoracic portion of the spine, which is conclusive evidence in behalf of the opinions of E. H. Weber relative to the form of the thoracic vertebræ and the lumbar intervertebral cartilages.

There remains yet one important question to

be settled with reference to the pathology of posterior curvature, namely, *whether, and to what extent, the intervertebral cartilages partake in its establishment?* That the fibro-cartilages of the spine materially contribute to the physiological curves of the latter, cannot reasonably be doubted from the investigations of Weber. It follows, therefore, that if their shape constitute an essential part in the form of the spine during health, it must be equally so in morbid conditions. Pathological anatomy has already removed all doubt as to this fact; for caries of the vertebræ invariably and consecutively invades the fibro-cartilaginous structure and more or less disintegrates it, although the process of disintegration, according to Toynbee, is not as rapid as in bones. The question mooted is therefore only: *whether the fibro-cartilages may become the seat of primary affection?* Most pathologists, in touching upon this point, are exceedingly reserved and disinclined to offer an opinion, and Nichet seems to be the only one to consider the fibro-cartilaginous structure susceptible to primary disease in the form of tubercular deposits. We deem it hardly worth while to dwell upon the subject, but are certainly of the opinion, derived from analogy, that the cartilaginous tissue would be the very last to be invaded by the so-called tuberculosis.

We are fully aware that cartilages in general are not pre-eminently susceptible to injuries, and that they bear a considerable amount of exciting cause without morbid reaction. The fibro-cartilaginous structure of the spinal disks seem to be possessed of a higher degree of vitality, judging from the vascular supply they receive. Considering, therefore, that the elasticity of the spine exclusively, and its flexibility, in a great measure depend on the cartilages, it is very evident that any undue tax of either must inevitably infringe upon their status and lead to structural changes. Quite a number of posterior curvatures having come under our observation, moderate in symptoms and size, and of a rounder form, our suspicion was excited with reference to the fibro-cartilages. But the opportunities for post-mortem examinations were so rare in this species of curvature, that up to the year 1854 we were left in doubt whether our suspicions had any foundation. In that year Dr. Lewis A. Sayre consulted us in the case of a young man who had during the preceding eighteen months suffered from disease of the spine and lumbar abscesses. The patient was twenty-one years of age, about six feet in height, greatly attenuated and anæmic. What attracted most our attention was the perfect straightness of the spine, of which the plaster cast now exhibited, Fig. 49, is a correct copy.

Fig. 49.

The patient soon after died in uræmic convulsions induced by Bright's disease, and the pathology of the case underwent a thorough investigation, in which Prof. Alonzo Clark rendered his valuable assistance.

The specimen before you, gentlemen, very remotely exhibits the condition observed when recent. It consists of the lower portion of the spine from the fifth thoracic vertebra downward. There were large cavities between the psoas and quadratus muscles, communicating internally with some small carious excavations of the spine and externally with the sores on the back. In its passage the matter had corroded the left transverse process of the third lumbar vertebra. This specimen was perfectly straight when removed, and its present bend has been caused by the mode of its preservation. The first striking appearance was the unusual thickness of the fibro-cartilages, their exuberant protrusion from between the vertebræ, and their entire loss of elasticity. By a moderate longitudinal pressure, the bones were almost brought into contact, and had to be pulled asunder. There was but little difference in this respect among the different disks. While being pressed, a fatty, whitish detritus came forth, which, under the microscope,

exhibited fragments of the structure, spindle-shaped cells containing granules and fat globules in abundance.

The spine itself, longitudinally divided, presented *no tubercular deposit* and but moderate hyperæmia.

On the opposite surfaces of the second and third lumbar vertebræ, there were two central excavations, corresponding in seat; a little larger in the third, with a loose sequestrum. Between these vertebræ the cartilage was almost entirely destroyed, the anterior lamina only being left. On the inferior surface of the fourth thoracic vertebra, there was likewise a central carious excavation of small size, and surrounded by that dense osseous tissue which, you recollect, passes by the appellation of sclerosis or eburnated structure. In this specimen it can still be seen, the cartilage protruding and filling the said cavity.

Now you notice that in the specimen before you, there are but four carious places, namely, at the fourth thoracic, second and third lumbar vertebral bodies, and the left transverse process of third lumbar vertebra, whereas the rest of vertebræ is perfectly sound. But one intervertebral cartilage (between the second and third lumbar vertebræ) has been destroyed, while the others have not lost in substance; on the contrary, they appear enlarged.

Now, gentlemen, it is very evident that the caries of the three named vertebræ have not caused the disease of all the intervertebral cartilages, and especially not of those that occupy a seat remote from the respective bone diseases. This would be barely impossible. But is it equally impossible that the disease of the three vertebræ originated in the cartilages? We think not! and for the following reasons:—

1st. All the intervertebral cartilages are seriously affected, and have suffered structural changes, whereas but three of the vertebral bones exhibit disease.

2d. The disease of the latter is located at the surfaces which are in close anatomical connection with the intervertebral cartilages.

3d. The disease of the osseous structure is evidently proceeding from the periphery toward the centre, taking the sclerotic tissue in proof.

4th. Comparing the morbid condition of the cartilages with that of the vertebræ, and bearing in mind, what Toynbee has observed, that the former disintegrate with less rapidity than the latter, it must be conceded that the pathological changes are not only more extended, but also farther advanced in the cartilages than in the bone.

We feel therefore justified in inferring that in this specimen there is primitive disease of the fibro-cartilages, with consecutive caries of the fourth thoracic, second and third lumbar vertebræ. Nor can it be doubted that the disease consists in inflammation. The absence of the ordinary inflammatory products is by no means incompatible with this diagnosis, in as far as the modus of nutrition would necessarily modify the inflammatory process. This view is moreover strengthened by the cause of the malady, namely, over-exertion and fall.

Permit me, gentlemen, to ask your particular attention to the physical effects of the disease, namely, the *entire loss of elasticity* of the cartilages. The perfect absence of all elasticity accounts readily for the *straight deformity* which the spine presents, having simply been occasioned by the supine posture continued during eighteen months on a hard and even mattress. Supposing the patient had walked about with this state of his spine, what would have been the result? Unquestionably a posterior deformity! For a spine that yielded its form to comparatively a few pounds of dead weight in the supine posture would have equally yielded to the greater superincumbent weight in the erect posture.

This point is of invaluable practical importance for the treatment of posterior curvature, and we are not aware that it has, by any previous record, been put in the same high relief.

Gentlemen, having discussed the pathological conditions of the spine that underlie posterior curvature, we may now with propriety take into consideration the all-important question, *whether they are such as to admit of a partial or total restoration of the normal forms?*

Competent pathologists will answer this question *with an emphatic no!* Spinal doctors will say yes! The former will refer you to their pathologico-anatomical observations. The latter will produce diagrams of fearful curvatures cured by a pair of stays, or by a patented spinal supporter, and that in a fabulously short time. If your credulity is not up to the mark, they will strengthen their assertion by referring you to the most eminent physicians, whose reputation is powerful enough *to convert ink into the milk of human kindness.*

It would of course be incongruous with the character of this audience and these lectures to meddle with the assertions of pretenders. We shall, therefore, at once enter upon the anatomical changes of those structures that essentially constitute the deformity in question. From this basis alone a rational answer can be given.

In reviewing the morbid changes of the cancellated structure in endostitis, we notice first hyperæmia and general infiltration of plastic material. The connective tissue swells, becomes filled with a gelatinous and somewhat fatty substance, forms exuberant vegetations, occupying the cancelli, and, in the same ratio, the bony structure becomes rarified by either change or interstitial absorption. This process has been designated by Rokitansky as osteo-porosis. If the process of inflammation proceeds farther, the cellular bodies are converted into parental pus cells, which burst and diffuse the embryonal pus cells through the entire structure, (purulent infiltration;) and if the inflammation be circumscribed, it gives rise to the formation of an abscess. In general endostitis, the bone becomes soft and pliable as in rachitis, and even more so; a condition which has as yet not been sufficiently appreciated as a mechanical element in deformities.

We have had opportunities to observe this process in analogous bony structure; we have found the bone as soft as cheese, and the epiphyses of the cylindrical bones bend upon themselves and the shaft.

The recovery of the cancellated structure from inflammation or suppuration is accompanied by the formation of denser osseous material (osteosclerosis) and irregularly shaped, often proliferous osteophytes.

Now, gentlemen, it is self-evident that the softened vertebral bodies cannot sustain the superincumbent weight without being altered in size and shape. The thoracic vertebræ suffer, therefore, more from the disease than the lumbar ones, on account of their primitive form and position at a curve.

We have but one way of *obviating the mischief*, that is, to place the patient in the supine posture, and remove thus the superincumbent weight. All we can possibly accomplish thereby, *is the arrest* of the deformity. But the *already acquired* deformity we have no means of affecting, because *we cannot change the shape of the vertebral bodies.* If it be thus impossible to produce any change in the already established deformity at a period when the bones are soft and pliable, it is still more out of our range when the bones are consolidated and incrusted by new bony deposits.

With reference, then, to those posterior curvatures of the spine that originate in endostitis of the vertebral bodies, we can give but *a negative answer.*

As to periostitis of the spine, we presume the deformity to be but an incidental symptom. At any rate, we have observed cases and conducted them to a favorable termination without any noticeable deviation of the spine. If curvature of the spinal column at all ensues, it is by caries of the vertebral bodies and consequent loss of substance. Whether the superincumbent weight is sufficient to produce the curvature, or whether the subsequent formation of sclerotic tissue in both the bones and the periosteum draw the spine forward in a similar manner as the cicatrix of burns, we do not feel quite sure. But, certainly, we are debarred from means *of correcting a deformity* that has become established by so material anatomical changes in the spine, and has been rendered still more permanent by osteophytic bands, passing from one part of the spine to the other.

In fractures of the spine, we have to deal with different mechanical elements. There is the alteration of form and relation of the vertebræ. Next come the incidental changes of the structure; and last the callus. We believe that rest, immobility of the spine, and horizontal posture of the patient will constrain the inevitable deformity to the least possible degree. *But once produced, the curvature is permanent and unalterable.*

As to softening of the intervertebral fibro-cartilages, the question is open for discussion. We intimated to you that we had seen *but one well-authenticated case of this description.* Our clinical observation has, however, brought us in contact with quite a number of instances which we feel strongly induced to classify under this head. There was an unusual degree of flexibility of the spine, and comparatively little suffering. The local symptoms were moderate and scarcely ever combined with suppuration. Recovery, though slow, was mostly perfect. These were the cases in which we *succeeded in slightly reducing the posterior curvatures, but were never successful in completely relieving one single case.* Considering that the flexibility of the spine

chiefly rests with the intervertebral cartilages, and that the morbid process renders their structure still more soft and yielding, and, finally, that mechanical actions can be brought to bear upon them by position, it would seem that this was the only form of posterior curvature in which positive remedial assistance could be rendered.

The case detailed on a prior occasion, cannot be admitted as a solitary one. The susceptibilities of the intervertebral cartilages are more or less the same in every individual, and traumatic injuries exercise their effects upon the flexible portion of the spine first. These views may be speculative, but they are certainly not irrational. At any rate, the case submitted cannot fail to invite your interest, and direct future pathological inquiry. The abnormally straight form of that spine is in itself the most direct answer to the question propounded. But it is certain that this influence on the form of the spine lasts just as long as *the cartilages are soft and pliable*, as long as *the active disease of the structure exists.* The recovery is qualified by the formation of firm sclerotic tissue more or less deficient in elasticity, and therefore unalterable in its form.

From the preceding remarks it would generally appear that the susceptibilities of posterior curvatures to correction are but slender. That in most the progress of that symptom can barely be arrested, and that as soon as the affected tissues have returned to a state of relative health, amendment of the form has likewise become impracticable.

The specimen now presented, Fig. 50, shows you conclusively the correctness of these remarks. It is well, gentlemen, to know the latitudes of our usefulness beyond which pretensions commence. We shall now occupy your attention with the external causes of gibbus.

It is rather strange that the occurrence of traumatic injuries to the spine by falls, twists, contre-coup, etc., has been generally slighted by surgeons, and their influence underrated as the cause of posterior curvature, whereas constitutional causes have been admitted with eager readiness. We can account for this singular disregard of traumatic injuries but in one way, namely, that their consequences *ensue at so late a period as to admit hardly of any causal connection.* And yet analogy and daily experience amply teach us that the affections of bones, cartilages and tendinous structures are extremely tardy in their development. That between cause and signal morbid effect many months may pass by before the latter presents its gross and noticeable manifestations. Occasionally we may succeed in establishing the links between the two, but more frequently the causes are forgotten when their consequences appear. Ever since we have taken a lively interest and paid special attention to orthopædic surgery and the diseases of bones and joints, we have been forcibly struck with the above fact, we have collected all the clinical material that could possibly elucidate the point, and have found sufficient proofs to show that traumatic injuries are the chief cause of most of the maladies that befall the structures comprised in the spinal column and the locomotive apparatus. It may seem that we dwell too much on this subject, and repeat too often our views on the same point; but, gentle-

Fig. 50.

men, it is of the utmost importance that the truth should be put in such high relief as to be recognized and respected. The general opinion prevails, that posterior curvature is the concomitant of poverty, gross hygienic neglect, and deteriorated constitutions. Our clinical observations do not accord with these general views. In the first place, we have met the difficulty as often, if not more frequently, in high life, although we have had a fair share of dispensary practice. Next, we have found boys more numerously afflicted with gibbus than girls, and, in fine, we have seen the most healthy and robust constitutions invaded where no dyscrasic taint could be discovered without fastidiousness. These observations do not correspond with the generally received opinion, and rather indicate the preponderance of external causation.

Let us further bear in mind the experiments of Bonnet, who succeeded in producing, with comparative trifling exertion, extensive injuries of the spine, and remember that in infancy the spine is very differently constituted from that of adults, and therefore much more susceptible to be deranged and affected by traumatic influences. And lastly, if we consider the hazardous ramblings of children, we cannot hesitate to allot to violence its fair share in producing the trouble.

The more readily we admit the importance of the same, the more useful we shall become to our patients *in preventing difficulties which, once established, we are unable to cure.*

That other causes are likewise calculated to lead to the same results, cannot be denied. A sudden checking of a profuse perspiration is as much apt to give rise to a periostitis of the spine as to periostitis of any other part of the skeleton. Hooping-cough has, to our certain knowledge, in various cases been the remote causation of gibbus, and he who has seen the immense straining and flexion of the spine in that disease cannot be surprised at the consequences. We are of the opinion that in hooping-cough the thoracic portion of the spine is exclusively subject to the posterior deviation, and that the intervertebral cartilages are the main seat of the disease.

In but one single instance the deformity had to be ascribed to syphilis. This being so rare and exceptional a case, we beg leave to adduce its history. The patient, a German merchant, was forty-five years of age when attacked by gibbus. He had been three years affected, when, in consultation with two prominent practitioners of New York, we saw him.

His deformity comprised most of the thoracic vertebræ, and simply presented a larger curve than the normal one. The symptoms attending his case were quite insignificant. The pain was but trifling, the respiration almost undisturbed, and his rest was scarcely affected. Notwithstanding the deformity had slowly and steadily increased, and was quite formidable when we were called in. Up to that time the patient had followed his business avocation, had walked to his office down town, and scarcely felt any diminution of muscular power.

Besides his deformity, he presented some extensive gammatous swellings at the tibia and other cylindrical bones, occasional soreness of the palate, and increased discharge from the nostrils. On change of weather he experienced pain at the swollen bones, but he was free from pain in good weather. For some twelve years he had been treated for chronic rheumatism, and repeatedly used the decoction of Zittman, besides other remedies.

His physicians had set the case down as caries of the vertebral bodies without suppuration, had repeatedly applied the moxa, actual cautery, and the like remedial agents, but the patient had derived no benefit whatsoever.

On a close examination into the antecedents of our patient, we made out a different diagnosis. With some reluctance the patient admitted to have been affected with chancre as early as 1830; had undergone a treatment with calomel under the least auspicious hygienic circumstances. The disease had returned in less than a year, when, under his own responsibility, he had the treatment repeated. During the subsequent ten years he had variously suffered from syphilitic symptoms, and been variously treated for them. The affections of his bones were of an early date, but they had been kept in submission by medicines, and never allowed to extend.

In the absence of any other plausible cause of the deformity, no alternative was left but to ascribe it to the effects of syphilis, for which we had, indeed, positive proofs.

That syphilis may invest the vertebræ, has been conclusively demonstrated by Colles, although it is conceded to be of rare occurrence. In the present case there were no signs of a structural affection of the vertebræ. no disintegration of the surrounding soft tissues, neither abscess nor fistulous openings denoting caries.

That cartilages are not exempt from syphilis, is beyond doubt, though clinical observations do not

extend to the fibro-cartilages of the spine. That these were, however, affected in the case under consideration, seems to be conclusive from the absence of symptoms appertaining to the vertebræ, and positively from the round form of the gibbus and the moderate symptoms attending the deformity. Not unlikely the case had been initiated by syphilitic periostitis of the spine, the formation of gammatous exudation below the periosteum involving secondarily the fibro-cartilages.

We of course advised rigorous anti-syphilitic treatment; and from all we have learned since, (1854,) we have good reason to believe that the patient was greatly benefited, and his deformity brought to a stand still.

Before closing the chapter on the causation of posterior deformity, we propose to offer a few remarks on the constitutional causes of this difficulty. In every handbook on surgery scrofulosis is generally charged with the mischief. Now, gentlemen, it would be folly on our part to deny *in toto* such constitutional causes that derive their existence from bad hygiene and deranged nutrition. We acknowledge them to the extent of their reality, but consider it equally unjustifiable to enlarge their part in the disease by hypothesis or arbitrary adjustment, as is so frequently done. If we can clearly establish other plausible causes of the trouble, why should we recur to a strumous diathesis? A healthy child may meet with an accident; deformity of the spine may ensue in an insidious way, the constitution becomes necessarily infringed, the patient anæmic and attenuated from pain, want of rest and appetite. Thus we have the ordinary effects from ordinary causes, as we can observe them in daily pursuit of our avocation, a clear case throughout.

Yet we are constantly directed to mystify ourselves, to silence our logic in behalf of a preconceived idea. It is high time that we arouse from the lethargy into which we have been thrown by individual authority, that we, as it becomes inductive science, recognize the only legitimate authority, namely, the clinical fact, and resume independent investigation. The book of nature is open to all of us, and there is truly no necessity to read it always with the spectacles of others.

Gentlemen:—Upon *traumatic*, or at least *mechanical injuries* of the spine, falls, then, the larger ratio in causing posterior curvature. We accept this theory of causation in preference to the long-favored tubercular disease, for the following reasons:—

1. We have traced to mechanical causes *almost all cases* that have come under our clinical observation.

2. The deformity happens much more frequently among boys than girls.

3. The deformity occurs almost exclusively during infancy and its heedless wranglings, consequently at a period when the spine is yet imperfectly developed, consisting of numerous fragments, held together by cartilage, and therefore easily deranged.

4. The deformity exempts no social class, and is as frequent a visitor of the wealthy as of the poor, if not more so.

5. Although no portion of the spine is exempt from the deformity, yet that region is most commonly the seat of deviation, which, according to Bonnet, is *the chief recipient of injuries*, namely, *the thoracico-lumbar portion*, Figs. 51, 52, 53.

6. *The efficacy of the recumbent posture and mechanical contrivances, calculated to secure rest to the spine.*

7. The favorable *results of antiphlogistic, and especially cold appliances.**

8. The *negative* effects of constitutional, and the specific antiscrofulous treatment.

The inquiry into the pathology of posterior curvature is obviously conclusive as to the fact that *the deformity is not the disease itself, but one of its symptoms*, and not without some reasons has Bonnet termed it *secondary dislocation of the spinal column*. The array of specimens in plaster of Paris before you demonstrates that—

1. Posterior curvature is not a rare deformity.

2. It may involve any part of the spinal column.

3. It may assume *the form of an angle or of a large curve;* and that

4. It more or less deranges the form of the trunk.

With one exception, all specimens belong to the tender age from the second to the sixth year of childhood. Before that time you will only exceptionally observe it, and after that it originates from exceptional causes alone. It seems, therefore, that at that circumscribed period of life the anatomical predisposition rests.

* Prof. Esmarch in Archiv. der Klinischen Chirurgie, B. i. Heft. 2. Berlin, 1860.

As to the seat of the deformity, you notice from our specimens, all being taken from life, that no portion of the spine is exempt, though it happens more frequently in one part than another. Thus it is rarest in the cervical, less rare at the lumbar, oftener at the thoracic, and most frequent at the thoracico-lumbar region of the spinal column. You will remember that the last is exactly the place where fractures usually happen, and where injuries take more effect than elsewhere.

Kyphosis is essentially of *slow growth*, unless in case of fracture and immediate displacement. *Between its remote cause and its final appearance weeks and even months may intervene.* The symptoms attending its development are mostly insidious, and of a general nature. Considering the structures involved in the deformity, that it had been wrangling with other children, and been thrown upon the ground, etc. The cause had at the time attracted no notice, since the patient *did not complain;* had enjoyed afterward and for some time its usual health, and that when it had complained, its troubles had been *so trifling* and *general* that nobody had thought of the fall and the spine.

The phenomena characterizing the primary results of spinal trouble are, as already stated, of a general nature, and it is not without difficulty that we can connect them with their true source:

1. There is a general debility of the child, with indifference to activity.

2. The patient appears sallow, pallid, and anæmic.

3. Its appetite is indifferent, its urine turbid and concentrated, (from excess of urate of soda,)

Fig. 51.

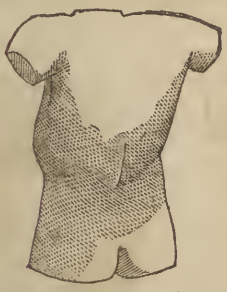


Fig. 52.

Fig. 53.

and their slow nutritive process, this should not surprise us, for we observe the analogous facts in all diseases of the skeleton and its immediate appendages. The difficulty may even exist for some time without being noticed at all, so little inconvenience may be occasioned thereby. As a general thing, the deformity has existed for some time, has considerably advanced, and has already made some impressions upon the constitution of the patient, when your attention is invited. The apparent absence of all external causation, and the constitutional derangement along with the curvature, have misled so many authors to presume the pre-existence of dyscrasia, or, as it is called, a strumous diathesis. These suppositions, we opine, are utterly devoid of foundation.

Careful and patient investigation will mostly discern the fallacy.

You will ascertain that the child has been well, and often rugged up to a certain period, when it met with a fall upon its back, from a fence, a staircase, a table, or a chair, as the case may be; its bowels irregular, its rest uneasy, and interrupted by frequent moanings.

4. The patient prefers solitude to the company of its playfellows, and if urged to take a part in their sports, it will soon drop off, lay quietly down, and assign shortness of breath and agitation of the heart as the cause.

5. Where and whenever the patients stand, sit, or listen, they will always manage to procure some sort of support for the back, toward which they lean; and in want of anything better, will place their arms on a table and push the shoulders up, or support the head by the arms upon the knees. If anything, these positions are of a more decided symptomatic significance for diagnosis.

How long these preliminary symptoms may prevail is very uncertain, depending, of course, on the slow or rapid advance of the disease itself. This much is sure, that if the direct signs set in soon after the injury, we have a serious lesion to contend with.

Under the essential symptoms of the deformity, *pain, stiffness of the spine, and the protrusion of one or more spinous processes* occupy the first place.

The pain is very characteristic indeed. It is felt *around and in front of the body*, less at the spine itself, unless excited by percussion, contrecoup, or a sudden twist. At the cervical portion of the spine, the patients experience some difficulty in deglutition; at the thoracic portion, the respiration is impeded and becomes laborious. Singultus is a common accompaniment. At the thoracico-lumbar portion, the patient complains of pain in the stomach, and, exceptionally, of difficulty in the discharge of urine.

By placing the patient in the prone posture, however, and exploring the spine with *a hot sponge, by percussion*, and *by lateral movements of the body*, you will find no difficulty in ascertaining the exact seat of pain, and its irradiation through the cervical, intercostal or lumbar nerves.

The stiffness of the spine is likewise a significant diagnostic phenomenon, noticeable in the posture, gait, and the movements of the patient, in which the spine is concerned. In the erect posture, and in the gait of the patient, the spine is kept at rest, the head is fixed and slightly drawn backward, while the shoulder-blades are retracted and the thorax pressed forward. *The movements* are very careful, and with the view to obviate the slightest disturbance of the spine. The patient seems anxious for support, and will avail himself of everything. He leans forward upon a table, supporting his head by placing the elbows upon the table, and the hands below the lower jaw; or will throw himself across his mother's lap, by flexing the hip-joints, or across a chair; in picking something from the floor, will bend both hip and knee joints, and thus gradually and carefully approach the object, often supporting the body by placing the left hand upon the left knee. The latter movement is, indeed, very characteristic and decisive for diagnosis.

In order to ascertain the prominence of one or more of the spinal processes, the patient should be placed in a prone posture upon a firm mattress, when the spine of a child of that age should be almost straight as a line. Any projection will be readily noticed. Sometimes it happens that the consecutive incurvation or incurvations become established prior to the protrusion. In that case the disease is located below the incurvation or between the two, and the pain of the affected portion of the spine will complete your diagnosis.

If the deformity has existed for some time, and the patient has been permitted to walk, no diagnostic difficulty will be experienced. You will then find more or less posterior deviation of the spine, with more or less anterior curvature, which has been called *compensating curvature*. Over the kyphosis, the integuments become attenuated, so that the spinous and oblique processes are covered with integuments alone.

In the progress of the deformity, various consecutive effects are produced which deserve mention. Among others there are:—

1. *The malformation of the thorax*, which consists of the elevation of the sternum and ribs, whereby its width materially increases, and its length proportionately diminishes. Figs. 54 and 55. Whether the mobility of the ribs is simultaneously impeded is not yet decided; but we are inclined to believe it is.* This deformity of the chest has nothing in common with the so-called *chicken breast*, the result of rachitis and compression of the ribs from right to left, which happens even without posterior deformity.

Fig. 54.

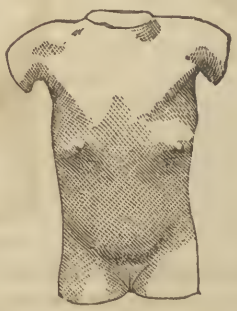


Fig. 55.

2. *General attenuation* of the body, which is mostly of permanent duration, and seemingly dependent on an impediment of vital organs and the great sympathetic nerve.

3. *Paralysis of the lower extremities.*—This symptom has been, by some authors, erroneously ascribed to mechanical compression of the spinal cord or the nerves. Clinical observation and

* Anchylosis of the ribs by osteophytes constitute, of course, permanent immobility.

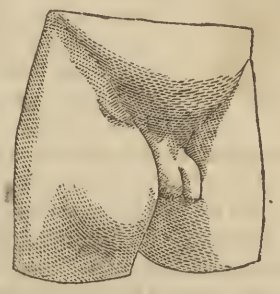
post-mortem examinations have, however, disclosed the real cause. The spinal cord is in such a manner suspended within the spinal canal as to accommodate itself to the numerous changes and postures of the body, without being interfered with. The intervertebral foramina are likewise larger than the size of their respective nerves demand. The numerous examinations of the spine, in cases of lateral and posterior curvature, have rather shown *the spinal canal and intervertebral foramina larger than the safety and protection of the nervous structure require.* But a few exceptional cases have been placed on record, in which abscesses had opened and sequestra had found their way into the spinal canal, giving rise to mechanical impediments. The true cause of paralysis consists in hyperæmia, irritation, and even inflammation of the membranes, and in a few cases of the cord itself. This supposition is borne out by negative and positive clinical facts; for the paralysis very often makes its appearance *in comparatively recent cases*, whereas advanced cases *may be free from it.* At any rate it seems to be entirely independent of the degree of deformity, and is scarcely ever noticed in lateral curvature, however aggravated. We have observed it, on the other hand, in acute cases of kyphosis, where all the symptoms denoted a high degree of inflammation of the spine and its adjacent structures. Remedies calculated to alleviate the existing active symptoms, as for instance leeches, cold fomentations, and the recumbent posture, most usually relieve paralysis, and we are cognizant of instances in which the latter disappeared in a few days. The paralysis comprises commonly the motor apparatus alone, and scarcely ever involves sensation. The motor fibres being in the anterior columns of the spinal cord, and nearer to the seat of the disease, are therefore more exposed. On the other hand, we have never observed paralysis in which the active symptoms of disease had entirely disappeared.

4. *Contractions of the flexor muscles of the thigh*, under the same pathological conditions, in which paralysis is met with. In some instances the symptom has been mistaken for an affection of the hip-joint, and treated accordingly. There is, however, no difficulty in its diagnosis. For the hip-joints are free from pain on pressure or motion, and neither abduction nor adduction is impeded. Moreover, the contraction happens generally in affections of the lumbar portion of the spine, and concerns the psoas and iliacus internus muscles, and is, therefore, simple flexion, without additional malposition of the thigh.

5. *Consecutive abscess.*—If the disease of the vertebræ or their adjacent structures has advanced to ulceration, the formation of consecutive abscesses is an ordinary morbid result.

This class of abscesses is known by the term of *cold abscess*, because the attending symptoms are of a low character, but little pain or discoloration of the integuments being observed. Occasionally these abscesses may gradually disappear *by fatty degeneration and absorption of their contents.* They make their appearance remote from the seat of the disease at depending places. If the matter collects below a continuous fascia, their form is diffuse, becomes, however, circumscribed as soon as the fascia gives way. In the specimen before you, Fig. 56, taken from an adult negro, afflicted with

Fig. 56.



caries of the lumbar vertebræ, you have both forms exemplified, namely, on the left a diffused and on the right a circumscribed psoas abscess. In ulcerations of the cervical vertebræ, the matter descends below the longi colli and their aponeurosis, raising both off the spine and encroaching upon the posterior wall of the pharynx, (post-pharyngeal abscess.) In descending, the matter may appear outside of the sterno-cleido mastoid muscle, and above the clavicle. But rarely do these abscesses open into the thoracic cavity. If the matter originates at the lower cervical portion of the spine, it may follow the course of the brachial plexus and collect in the axillary cavity. The pus that originates in the dorsal vertebræ collects usually in the posterior mediastinum, following the course of the aorta through the diaphragm, the iliac arteries, and making its appearance at the femoral fossa. In other instances the matter gets under the fascia

of the psoas muscle, and collects in the neighborhood of the small trochanter. Cases are known in which the matter descended into the pelvic cavity and perforated the rectum. The matter from the lumbar vertebræ follows either the course of the aorta and iliac artery or the direction of the psoas muscle, and accordingly collects either at the femoral ring or near the small trochanter. Sometimes the matter gets into the bursa of the ilio-psoas muscle and thereby enters the hip-joint, Fig. 57, and vice versa. The history of this very interesting case, and its pathological anatomy, was published in the *N. Y. Journal of Medicine*, vol. xii., 1854, to which we beg to refer. The specimen itself was presented by us to Professor Willard Parker. The patient having suffered for a long time from intermittent fever, which gave rise to enlargement of the spleen and leucæmia, met with *a fall upon his back*. Three weeks after the accident, his spinal trouble made its appearance, in the course of which psoas abscess formed on either side. On the left, it opened directly below Poupart's ligament. On the right there were several fistulous openings at and below the small trochanter, the cause of them being caries of the eleventh thoracic down to the fourth lumbar vertebræ. In its descent, on the right side, the matter had, most likely, by means of the ileo-pectineal bursa, entered the hip-joint, and caused great disintegration of its component parts. Besides, the matter had cut across the femur below the small trochanter, so that the limb was connected with the body only by the muscles. The discharge of matter may take occasionally a shorter route toward the back (dorsal and lumbar abscess) and sometimes discharge itself in three or four different directions.

Fig. 57.

Diagnosis.—If you bear in mind, gentlemen, that posterior curvature is not the disease itself, but one of its attending symptoms, and that the disease leading to posterior curvature may be of a different character, and invest different structures, you will at once realize the difficulties that surround incipient cases. The early recognition of the primary trouble is of the most practical importance; for it will give you an opportunity of mitigating, if not preventing, its progress. Once established to a certain extent, deformity will inevitably set in; and how little control we have over it, has been clearly demonstrated on a former occasion. If, therefore, a patient is presented to you, who, after a previous accident, manifests some of the symptoms appertaining to an affection of the spine, irrespective of deformity, you had better at once set it down as an incipient case of the latter, and act accordingly and without delay.

Periostitis of the spine is seldom accompanied with great pain. Deformity is superadded at a late period; whereas consecutive abscesses are early observed. It is chiefly in periostitis that abscesses are formed in different places, both near the seat of the disease and on depending points. In inflammation of the intervertebral cartilages, the deformity assumes the shape of *an arch*; the symptoms are mild, but protracted; ulceration and abscesses are rare, and paralysis and contractions are not often observed.

In endostitis of the vertebræ, we notice the sharp projection of one spinous process, and the deformity assumes gradually an angular form, in which the first protruding spinous process occupies the highest position. This diagnostic mark is, however, not conclusive; for we have likewise observed it after fractures and diastasis of the spine. The only differential symptom lays, perhaps, in the time of its appearance, so that we may expect a protrusion of a spinous process much earlier after a direct traumatic cause than after ostitis and endostitis. Moreover, consecutive abscess, paralysis, and contractions are much more usual after the latter than after the former; whereas the pain in walking and in pressure is more intense in traumatic deformity. While, therefore, the differential symptoms between the various affections of the spine are but very general in incipient cases, they lose all significance in advanced cases, for the simple reason that the affection of one structure becomes gradually continuous to the other, as it is in joint diseases.

Prognosis.—From our preceding remarks on the subject, it must be inferred that posterior curvature is a much more formidable complaint than empirics are capable of realizing, and not as intractable as is generally presumed by surgeons, who link it with tuberculosis. The pathological diversities of the complaint render a

sweeping prognosis impracticable and worthless. In fact, each case is to be carefully qualified before a reliable prognostic conclusion can be arrived at.

Recent cases, of course, admit of a better prognosis than advanced ones. Softening of the intervertebral cartilages is of less prognostic importance than periostitis, diastasis, fracture or inflammation of the vertebræ. Of all curvatures, that allows the best prognosis which originates in hooping-cough; an arched curvature is less dangerous than an angular one. Hooping-cough, inflammation of the lungs and air-passages are aggravating complications. Paralysis, in connection with posterior curvature, is indicative of an active, morbid process, although itself commonly capable of relief. The same view may be entertained in reference to contractions. The formation of abscess constitutes an advanced disintegration of the component structure of the spine, and therefore may be looked upon as a serious and most unfavorable symptom.

In as far as the deformity itself is concerned, we candidly believe *that improvements are the exceptions;* and that it must be considered a satisfactory result to keep the deformity in statu quo, notwithstanding all to the contrary that may have been asserted. But in some *aggravated cases*, the best and most judicious treatment may not even suffice to prevent *the steady increase of the deformity.*

It is evident that our prognosis is strictly to be guided by the pathological character of those diseases which lay at the foundation of the curvature, and not by the latter.

Treatment.

Gentlemen:—In the treatment of posterior curvature, all the changes and fluctuations have taken place, to which the successive theories on the proximate cause of scrofulosis have given birth.

When the humoral pathology prevailed, it was held that in scrofulosis the blood was contaminated by a *peculiar dyscrasic agent*, whose elimination, through the secretory and excretory organs, was laid down as curative indication.

The solidarists contended that if the nutritive fluid of the body was thus contaminated, the morbid principle would inevitably be incorporated in the solid structures. In order to remove it, it had to be brought back to a fluid condition, taken up by the lymphatics, before its elimination could be effected. The chemico-physiological school disputed in toto the existence of a materia peccans, and sought in the inefficient oxydation of protein the acting cause of scrofulosis. In fine, the professional mind has been tending toward a mere nutritive derangement as the pathological basis of the disease, and hence regimenal treatment has taken the lead.

The shifting of these hypotheses has been so gradual and imperceptible that we have scarcely noticed the transmutation from one extreme to the other. When mercurials and antimonials were the anti-scrofulous panacea, the diet was low, animal food being highly objectionable. When the production of good protein was the object, iron, quinia, with the most liberal diet, was commended.

We hear now but little about theories—the term alone having outlived them. Empiricism has now its sway. The followers of Rademacher may just as well term scrofulosis a beef, air, and iron disease.

The barbarism of former periods is, however, still maintained in the local treatment, and moxa, issue, and the like derivatory remedies, are commonly resorted to. If the pretensions of legitimacy and orthodoxy were not made, we would pass in silence over a treatment which is in direct opposition to all pathology and reasoning. As it is, we deem it yet worth our while to subject it to a searching criticism. For the truth should be so oft repeated until it has driven away ignorance. We have, of course, nothing to do with the individual representatives of that treatment. For it is either rational or irrational, and must stand on its own merits. And no individual authority, of whatever magnitude, can make an absurdity reasonable.

The local treatment, which we are now about to analyze, could not have perpetuated its sway for so long a time, had the pathology of posterior curvature been thoroughly investigated, and the fact established *that a series of diverse pathological conditions underlies that complaint.*

Admitting, however, for argument's sake, the tubercular theory of causation, it must be patent to the crudest mind that issues, setons, moxæ, and the hot iron are inoperative appliances for the removal of tubercular matter. And if clinical facts were attained to substantiate their therapeutical efficacy, they would tend to prove the fallacy of the theory rather than its correct-

ness. Such facts do not, however, exist, except in imagination.

The advocates of this local treatment seem to repose but little confidence in those appliances generally in tubereulosis, not having attempted to put them in operation when lungs or other organs are invaded. Is not this inconsistency the strongest condemnation of their plan?

We are, however, informed that local derivation is less designed against tubercular deposits themselves than against the process that initiates them. The idea prevails, that some sort of inflammation preeedes tubercular invasion, which might be mitigated, and its sequences prevented by timely establishing a more intense inflammation in proximate and less important structures. On the surface, such reasoning may seem plausible. Mature reflection will readily disclose the fallacy. In the first place, the very commencement of tuberculosis is but rarely observed, and, least of all, in bony structure. We obtain clinical cognizance mostly, then, of these so-called tubercular depositions when they are established and tend to their termination. Next, it is against all physiological law to derive from one structure to another by the same set of nerves and vessels. It would rather seem that the disease is directly stimulated by these so-called derivatory appliances.

Besides the unrefutable physiological objections to derivation, they are so severe as to gravely affect the constitution, creating irritative fever, disturbing rest and appetite, and causing drainage upon the system, which is already taxed beyond endurance. In fine, local appliances of this kind materially interfere with the supine posture, considered indispensable in incipient cases of posterior curvature.

Having, however, disputed in toto the existence of bone tubercle as the cause of kyphosis, and shown the real pathological condition of this complaint, the question of derivation presents itself in another shape, namely, *whether derivation can possibly benefit the actually existing morbid condition, of which posterior curvature is but a symptom?*

As yet, it has not occurred to any surgeon to interfere in the reparative process of fractures, and diastasis in other parts of the skeleton with derivatory measures; position and adaptation of the fragments being held sufficient.

What is needless elsewhere, is equally dispensable in relation to the spinal column.

The same argument is applicable to traumatic inflammation.

With the balance of causes, periostitis, ostitis, and chondritis, and their respective structural consequences, derivation seems more plausible, on account of their being of more chronic and protracted course. We should, however, bear in mind that we scarcely ever have an opportunity of attending recent cases, that most of them are advanced when they come under observation, and that it is simply impossible to re-establish the healthy structure by derivation! There may be caries or necrosis; a sequestrum may have formed with consecutive abscess; the intervertebral cartilages may have become already disintegrated, lost their elasticity, and drawn the adjacent vertebral bodies into destruction, and so forth. What, in the name of common sense, derivation can do in re-establishing the normal anatomical status, is certainly not to be conceived. The grossest ignorance in pathology alone can indulge in such fictions.

Since the theory of local derivation is untenable, and the practice of the same has given no satisfaction to either patient or surgeon, we feel it our duty *to advise its discontinuance as far as joint, bone, and diseases of the spine are concerned.*

There is still some difference of opinion with practitioners as regards the recumbent posture in the treatment of posterior curvature. Some surgeons hold that the horizontal posture, for therapeutical purposes, is not only dispensable, but directly prejudicial to the general health of the patient. The necessity of rest and the recumbent position in kyphosis follows from the morbid condition of the spine. *A softened and physically deranged spinal column is obviously unfit to support the superincumbent weight of the body, and the erect posture must necessarily tend to stimulate the disease, and to aggravate the existing deformity. No spinal supporter can be substituted for the horizontal posture,* however ingeniously constructed.

The prejudicial effects of the horizontal posture upon the constitution of the patient are more imaginary than real, and, at any rate, grossly overrated. Our clinical observations, on the contrary, have elicited very different results.

While the child is suffering from some spinal trouble, it pines away, becomes pale and sallow, loses flesh, and is every way declining. It neither has appetite nor good night's rest, being, at the

same time, peevish and irritable. Each day increases these general symptoms.

In placing your patients in the horizontal posture, and enforcing it rigidly, you will in a short time notice changes for the better. In a few weeks he will assume all the attributes of health and strength, and fatten up. This has invariably been our experience, *irrespective of the length of time we had kept the patient on his back*, unless abscess had formed that run him down.

Pathology and clinical experience render, therefore, the horizontal position one of the most valuable and indispensable remedies, without which *we should peremptorily refuse to burden ourselves with the responsibilities in attending a case of kyphosis.* Horizontal posture is, in our humble opinion, as needful in the treatment of progressive posterior curvature as in fractures of the lower extremities, and for the very same reasons, whatever the retroflexion upon the general health of the patient might be.

Since the horizontal position is most effective when combined with immobility, that is to say, with rest of the spine, some precautions are to be observed in connection therewith. If the spine already protrudes, or is very tender on pressure, an ordinary bed does not answer, for the patient could not endure the pressure of an even and firm mattress for any length of time, whereas a feather bed would heat too much, and favor bad position. The best, under such circumstances, is *a water-bed*, which both yields to and supports all parts of the body, and exposes none in particular to exceptional pressure. Indeed, nothing can equal the excellence of a water-bed for this purpose, and it should be provided for the poorest of your patients.*

At the beginning, the patient is so much delighted with his new accommodation as to submit patiently to restraint, if, indeed, it could be thus termed. As the improvement advances, he may need shoulder-straps and a belt to constrain him in the recumbent posture, and they should be applied. This apparatus is to be fastened to the blanket with which you have to cover the water-bed, in order to obviate its heating effects.

With the water-bed moderate extension of the spine may be combined, both to correct as much as practicable the form of the spine, and to counteract the reflected contraction of the dorsal muscles. The plan for extension is the same as with other parts of the skeleton. Stout adhesive strips are fastened from the hips downward along the lower extremities to pulley and weight at the foot of the bed. Other strips are applied to either side of the spine above the affected spot, and in a similar manner carried to the head of the bed. Such an extension acts directly upon the affected parts; its degrees can be modified, and we have found it a grateful auxiliary in the treatment of *incipient kyphosis.* The old mode of extension between the neck and pelvis has not been found effective.

If the spine is *tender* and *hot*, the respiration impeded and hurried, the circular pain of the body severe, and the patient feverish, we resort to *repeated* application of leeches, inunction with mercurial ointment, to *persistent* use of cold temperature, besides the appropriate constitutional treatment. From leeches we have derived great benefit in these cases, and they are indeed invaluable aids. We mostly have but a few applied at a time, and repeat them as often as the case may demand. A moderate depletion is scarcely felt by the patient, and its repetition is better calculated to relieve the hyperæmia of the affected structures than a depletion on a larger scale. The latter may, however, be needed in *very recent and severe injuries* of the spine, causing violent inflammation, and when the patient is robust and strong. Artificial leeches may be substituted for the natural ones with the same result.

Cold temperature is a most valuable auxiliary, and its systematic use has been justly placed in high relief by Professor Esmarch, of Kiel. While it is being applied, the patient should lie on the face upon a water-bed, the spine be protected with a piece of thin flannel, and the ice-bag suspended so as to guard against escape of water, and be always properly filled.

The prone position of the patient being rather inconvenient, and interfering with extension, we resort to ice applications, only in severe and very active cases. In such, however, we persist in its use until the alleviation of the active symptoms is accomplished, and in those cases it constitutes a most valuable and indispensable remedy.

Rest, supine posture, extension, and local antiphlogosis comprise, then, the treatment of incipient cases of posterior curvature, and their judicious application affords all desirable relief to the patient. They almost arrest the disease,

* Messrs. Wade and Ford, of New York, have been induced by the author to keep water-beds of all sizes on hand, which are, of course, cheaper than the ordinary-sized ones.

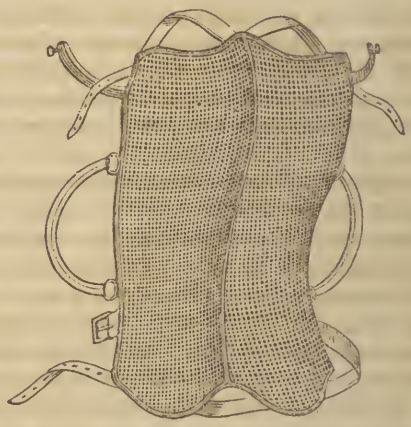
and consequently put a stop to the growing deformity. From time to time repeated and careful inspections should be instituted to ascertain the progress or regress of the disease, and all symptoms should have been silenced for some time, before the treatment is changed. It may not be safe to alter the position in six or twelve months. In children of that age, time is of little, but health and form of great, importance. As a general thing, gentlemen, the patients do not only not suffer from the confinement, but, on the contrary, bear it exceedingly well. If you should find, however, that your patient does not progress as well as might be expected, that he becomes pale and attenuated, which cannot be accounted for by the advance of the local trouble, and even without this change, it may be advisable to allow passive open air exercises. In order to accomplish this without detriment to the spine, we have constructed and frequently employed *a dorsal cuirass*, fitting accurately to the posterior half of the trunk, and thus supporting the spine and body so perfectly that its form is thereby maintained without the possibility of an alteration,

Fig. 58.

Fig. 58. The making of the cuirass requires a well-taken cast of the body in plaster of Paris. The cast serves as a last upon which the apparatus is framed.

The cuirass consists, you perceive, Fig. 59, of

Fig. 59.



a frame, made of soft iron, with a piece along the spine. The intermediate space is filled with galvanized wire-webbing, soldered to the frame. If well adjusted, the apparatus should fit to the cast like a shell, or like the gum-plate of artificial teeth. The frame is then well padded, and covered and fixed to the body by a belt and two shoulder-straps. At the side of the instrument there are two leather handles affixed, by means of which you can lift and carry the patient in a horizontal position.

Being securely placed in this apparatus, the patient may be drawn in a little wagon, or may enjoy the open air in a carriage drive. Thus the tediousness of the confinement is agreeably interrupted, the general health is properly cared for, and one of the objections to the imposed restraint overcome.

If the improvement of the patient proceeds satisfactorily; if you find that his general appearance becomes stronger and healthier; if he fattens up, exhibits good appetite and rest; if there remains no soreness at the spine; in fine, if all the symptoms of his local disease have vanished for some time, then, and not before, you may allow the patient *to creep on knees or elbows*, and take thus some active exercise alternately with rest. With the return of new pain and febrile excitement, the recumbent posture should be resumed, so as not to risk a relapse of already subdued troubles. But if, on the contrary, the patient continues to do well by this treatment, you may supply him with

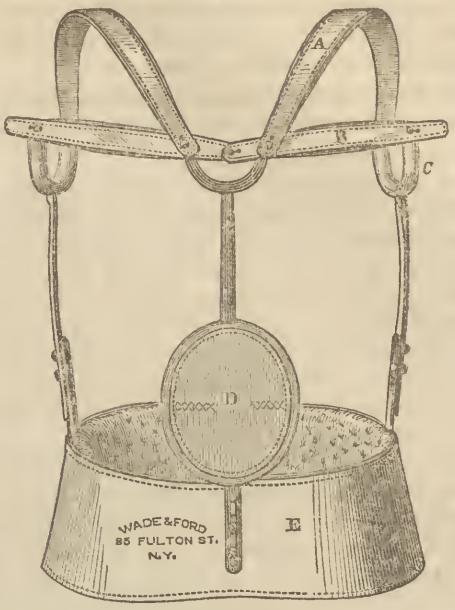
a supporter, and permit the erect posture. For a long time you have still to watch the effects of erect locomotion upon the spine and the constitution, and take prompt measures if new inflammatory symptoms should manifest themselves. The patient should, moreover, be advised not to indulge in violent exercises, even for years to come; for we have observed relapses from such causes in perfectly relieved cases as late as five years. In one of them, terminating fatally, two osteophytes had been fractured which had held the vertebræ together.

About the necessity and usefulness of mechanical appliances to the curved spine, there is yet some diversity of opinion among surgeons. In former times their efficacy was greatly overrated. Spinal supporters and stays were deemed sovereign remedies for kyphosis, and have commonly been resorted to. Pathological investigation and experience have however dispelled that error. The *very best* mechanical contrivance is nothing more than "*a monitor*" to the patient, *restraining undue motion* of the spine, and *slightly sustaining the superincumbent weight of the body*. Stays are silly and reprehensible apparatus. They are not substantial enough to support the spine, but they are calculated to press upon the vital organs and interfere with their important functions. Competent surgeons do not employ or recommend stays.

There are quite a number of spinal braces in vogue, among which you may choose. You should however insist upon their accurate fit and efficiency. The former can be procured only by a cast of the body of your patient in plaster of Paris, upon which the apparatus is fitted and framed.

The efficiency of spinal supporters rests chiefly upon the construction of the belt, which should be wide, and so accurately surround the pelvis that it will not slip, and serve as a reliable foundation for crutches and the spinal brace. Most apparatus are faulty in that particular, and therefore utterly useless. The crutches are designed to lift the shoulders and carry their weight to the belt, without compromising the spine. The spinal brace is calculated to constrain the spine from undue motion by means of a well-fitted and padded dorsal plate. Such an apparatus we beg now to exhibit, (Fig. 60.) You notice that the belt fits accurately and firmly to its cast, and yet is light, being made after the plan of the cuirass. It consists of four pieces, connected by meta hinges, which facilitate its application, without

Fig. 60.



detriment to its solidity. The dorsal plate should be perforated, so as not to impede perspiration. The crutches are made of two pieces, in order to shorten or lengthen them. If the patient should grow, or his form be materially altered, the apparatus would lose its proper adaptation. In that case a new cast should be made of his body and the apparatus altered accordingly.

We can, of course, give but general directions as to the construction of such an apparatus, and you are to modify the same according to the individuality of the case. Thus, it may be necessary to raise one shoulder higher than the other, and to extend the dorsal plate to one side, over the ribs, if the spine tends likewise toward a lateral excurvation, etc.

The treatment of incidental complication will now occupy our attention for a brief space of time:—

1. In the malformation of the thorax in kyphosis, we recognize a compensating provision of nature, with which we have no pretense of interfering. The thorax widens in proportion to its loss of length. The change provides the necessary space for the lungs and heart, which dare not be interfered with by mechanical constraint.

2. The general attenuation of the body is

usually proportionate to the degree of deformity. The more we prevent the latter by proper treatment, the more we obviate or ameliorate the former. Inasmuch as the attenuation results from copious suppuration, we have to meet it by the most generous diet and tonics.

3. Paralysis and contractions yield mostly to a rigidly-enforced horizontal position of the patient, and local antiphlogosis.

4. In consecutive abscess, (dorsal, lumbar, psoas, and iliac abscess), we advise to puncture them as often as they fill again, if they are circumscribed; but to lay them freely open and divide the fascia when they are diffused. By the former procedure you relieve the parts in a most direct way, and limit the additional suppuration of the fistulous tract; by the latter, you prevent the mischief of the matter burrowing below the fascia ad infinitum.

The suggestion of Nélaton, to close the fistulous tracts by injecting tincture of iodine, is neither plausible nor practicable, and our experience has been against it. You gain nothing by obliterating the tracts, should you ever be successful with the injection, since you cannot reach and exterminate the cause. And as long as the latter exists, the matter will force its way in the old or a new direction.

As a matter of course, gentlemen, we can lay down but general points for your guidance, and must leave the details of the treatment to your own acumen. If we have dwelled much on the pathology and the local treatment of posterior deformity, we have done so because they are not generally and thoroughly understood by the profession. If we have said but little about the constitutional treatment, we have reason to presume that you needed no suggestions on that score. In fact, lectures on a special subject are necessarily confined to the specific features of the same, and have little to do with its generalities. At least, we conceive our subject in that light.

Since the delivery of these Lectures we have met with diverse clinical cases that in the most direct manner corroborate the views set forth in these pages, with reference to the causation of kyphosis; and some of our esteemed colleagues have taken great pains in furnishing us still more cases of this class. Thus, our friend, Dr. John Cooper, of this city, introduced to our notice Lawrence Gordon, fifty years of age, a carman by occupation, with the following history:—On the third of July, the patient drove his vehicle, heavily laden with wood, on a sloping ground. The elevation was firm, the slope soft, and one of the wheels cut deeply into the soil. Gordon exerted all his strength to balance the vehicle, by pressing with both hands against the lower standing wheel. Nevertheless, the cart turned over to his side, first bending his body violently forward, and at last, when he had to give way, he was thrown on his back, with the load and the cart upon him. On being extricated, a fracture of his sternum was discovered, about an inch below the manubrium. The case was deemed a serious one, and therefore sent to one of our public hospitals. Besides the symptoms incidental to the before-named fracture, he experienced much pain in the lower part of his back; volition of lower extremity was moderately impeded, and he could not void his bladder, on account of which the catheter had to be employed from the very start, and during the succeeding ten days, when this symptom gradually subsided.

From the statement of the patient, it appears that the trouble in his back did not excite the apprehension of his surgeon, nor was it thought to be in any way connected with the retention of urine. At the end of a fortnight, the chest symptoms having subsided, he was induced to rise, but could not keep himself upon his legs. It was his impression that the attending surgeon doubted the reality of his inability to move; a carriage was ordered, and the patient sent home. He most positively assures us that while in the hospital his spine was never examined. Relata refre!

Being introduced to our Clinic on the 5th of September, the patient presented the following condition: Good and powerful frame, but general attenuation—more marked, however, about the hips and in the lower extremities. His gait is peculiar to spinal affection, his spine being kept perfectly stiff; shoulder-blades retracted, and head slightly reclined. Walks with bent knees (to obviate concussion of the spine). No fever; appetite and rest good, although temporarily disturbed by circular pains around the waist, particularly after a day of exertion.

The sternum is firmly united, the lower fragment slightly overlapping the superior. There is no impediment in respiration.

The lower portion of the spine is very tender on pressure, but still more so on percussion. The twelfth thoracic, first, second, and third lumbar vertebræ protrude posteriorly, forming a gentle curve, in which the second lumbar vertebræ occupies the most prominent position. The superincumbent portion of the spine is antero-flexed. Locomotion is tolerably easy, though the patient has to move with bent knees in order to obviate painful jarring of the spine. There is still some slight trouble in the discharge of the urine, and the sexual functions have been entirely suspended.

The patient averred that up to date his spine had not been examined, and therefore learned for the first time that his spine had become deformed. How soon the deformity made its appearance after the accident cannot be precisely ascertained; but, judging from the degree it had attained when examined on the 5th instant, but two months after the accident, it may be reasonably inferred that the deformity was the immediate result of the injury, and has ever since and steadily increased in consequence of the patient having walked in the erect posture.

There can be no reasonable doubt that the accident caused a fracture of the second lumbar vertebra. We infer this from the position in which the patient resisted the upsetting of the cart, and which concentrated both his exertion and the weight of the loaded cart upon the thoraco-lumbar portion of the spine, unduly flexing the same, and from the early appearance of its deformity. Most probably a wedge-formed fragment has been chipped off the body of the second lumbar vertebra right in front. A mere contusion or sprain of the spine, or laceration of ligaments and muscles, could not have given rise to so early a curvature. Dislocation of the lumbar vertebra without fracture or diastasis is impossible. The seat of the fracture and its limited extent render the non-interference with the spinal cord compatible.

The permanent suspension of the sexual functions is easily accounted for by the seat of the fracture, and the descent of the spermatic plexus in front of the same; whereas the temporary impediment in the voiding of urine must be traced to the incidental extravasation of blood sinking down in the cellular tissue toward the hypogastric and sacral plexus, from whence the bladder derives its nervous endowments. It is much to be regretted that the diagnosis was not made at an earlier period, when rest and the recumbent posture for some months would have sufficed to obviate the deformity, and the inflammation which ensued.

This case speaks volumes in regard to the causation of posterior curvature, and we hope its record will tend to weaken the confidence in its presumed pathology.

Few subjects of pathology have received more attention on the part of the profession, and in none have the combined efforts of scientific investigation been more barren of practical results than in scoliosis. For centuries it has been known as a formidable and unmanageable infirmity, and as such it is still recognized by competent practitioners. Not only that the proximate cause of this deformity is shrouded in obscurity, but even its remote cause is still the subject of dispute. To recite all the plausible and partly ingenious hypotheses which in the course of time have been advanced, might be interesting, but of no practical benefit to you. Most of them did not outlive anatomical and physiological tests. Those that did, belong to history, and we feel little inducement to stir the dust.

However, it should be borne in mind, that the investigation of the subject is embarrassed by almost insurmountable obstacles. Incipient cases of scoliosis, which alone would disclose the pathological condition of the textures concerned, can scarcely be had for anatomical examination; and advanced forms exhibit merely the results, but not the direct causes. We are, therefore, limited to clinical facts, and much is left to speculation.

The old theory, imputing in a rather undefined way, to the osseous structure of the spine, the exclusive cause of the deformity, has never acquired great sway, and was speedily superseded by the theory of Delpech.

Lorinser* has recently attempted to rejuvenate the same theory in a series of contributions, valuable in many respects. The cases selected for his pathological investigation, exhibited softening, general infiltration and osteoporosis of the vertebral bodies, and he concluded that both scoliosis and kyphosis are akin in their proximate cause, and that the rapidity of their respective

* Bemerkungen über die Pathologie und Therapie der Rückgrats-Verkrümmungen. Wiener Med. Wochenschrift, No. 22, 23, 24.

development govern the shape of spinal deviation. The morbid and structural changes, described by that author, we cannot fail to recognize as the characteristic, rachitic infiltration with which either form of spinal curvature is undoubtedly compatible. But the error becomes self-evident when Lorinser strives to present that pathology for general acceptance in all cases of scoliosis, it being at variance with well-established clinical experience.

The doctrine of Delpech, of disturbed muscular antagonism is still in vogue, and most orthopædic surgeons base their treatment of scoliosis on that cause. The meritorious and systematic labors of the late Dr. Werner† have, however, so thoroughly proved Delpech's theory as inconsistent with physiology, that no well informed practitioner can any longer uphold it. With the firm guide of Dr. Werner's observations and experiments, we now perceive the fallacy and inconsistency into which Delpech has led us, yet we are still inclined to retain a plausible theory in preference to none at all.

We presume that you are not familiar with the writings of Werner, and hence we may consider ourselves justified in briefly adverting to his deductions. The antagonism of the muscular system has been based on the supposition, that each muscle or each group of muscles was equally balanced by another muscle or another group, and *that the form of the frame depended on the equal power of both.* Delpech consistently inferred from this supposition, that the form was necessarily disturbed as soon as this muscular antagonism was infringed by *a one sided increase* or *decrease of muscular power.* Whereas Werner demonstrates that the *muscular antagonism is a gross error* and *in reality does not exist.* In this assertion his experiments and physiological facts bear him out. His "Theses" tend to prove:

1st. That there is no antagonism between muscles as maintained by Delpech;

2d. That single muscles and the groups are unequally balanced as has already been demonstrated by Borelli;

3d. That the balance of power is simply subservient to the will;

4th. That the full measure of muscular power will produce results proportionate to the length, thickness, and leverage under which single muscles or groups act irrespective of antagonism;

5th. That the muscle, if not actuated by the will, is physiologically at rest;

6th. That this rest is complete and not impeded by the so-called muscular tonicity;

7th. That the muscular structure is endowed with contractile, but not with expansive powers.

8th. Hence, a contracted muscle cannot expand itself, but requires either the weight of the extremity or an antagonist to regain its full length to be ready for another contraction;

9th. The theory that a muscle becomes permanently contracted, and the extremity deformed when its antagonist is paralyzed, is *erroneous;*

10th. During a temporary contraction, the skeleton is drawn in the direction of the healthy muscle;— but as soon as the contraction is terminated, it will return to its original position by its weight, or may be reformed by assistance. Thus the forearm will extend itself, though the triceps be paralyzed. When the weight does not aid, as, for instance, in paralysis of the extensors of the fingers, it requires the other hand. In paralysis of the facial nerve, laughing or speaking, draws the face toward the healthy side. In this distorted attitude the face remains, because the contracted muscles, though at rest, cannot expand themselves. But the face can be pulled straight, and will remain so until again disturbed by a new exertion of the facial muscles.

11th. Permanent muscular contraction necessarily emanates from a morbid process, and cannot be regarded as a physiological act.

12th. A muscle can be at rest, whether extended to its full length or shortened.

13th. Contraction is inseparable from shortening, but the latter may exist without the former.

14th. Most muscles combine with their antagonist to effect a motion in a third direction. Thus the flexors and extensors of the foot affect both adduction and abduction.

These numerous facts, supported by conclusive experiments and observations, render Delpech's "muscular antagonism" untenable.

Its fallacy becomes, however, still more transparent as soon as its practical application is attempted upon habitual scoliosis, for it is utterly impossible, even among the warmest adherents of Delpech's theory, to settle the problem, whether the dorsal muscles are on one side

† Reform der Orthopœdie. Berlin, 1851.

weaker or stronger than their antagonists. Nor are they able to decide, whether the muscular preponderance exists on the convex or concave side of the deviated spine. At any rate, the dynamometer has not disclosed the fact that there is any preponderance of muscular power on either side.

On a similar base rest the views of Jules Guerin and those of Strohmeyer. When the former promulgated his theory of "Muscular Retraction," as the invariable cause of scoliosis, and the tenotome as its sovereign remedy; when he soon after adduced quite a number of cases successfully relieved by dividing the retracted muscles, the surgical world was electrified, and the suggestions readily embraced. The more sober surgeons of the time, Dieffenbach among them, at once remonstrated against the wholesale and indiscriminate use of the knife, declaring that only well defined muscular contractions should be subject to operation. The clinical test thus invoked and carefully instituted, led to perplexing results. For the muscles on either side of the curvature, in both the thoracic and lumbar deviation, would show themselves in one position retracted and in another relaxed, and the difficulties arose in determining which of them were to be divided. In the ensuing discussion on this point, some of Guerin's followers held that those muscles were contracted that were on the concave side, and *vice versa*. The consequence of this uncertainty was, that both groups were subject to the knife, and what was more astonishing still, both parties asserted the same good result. At this stage of the discussion, Malgaigne in his excellent Memoire* to the Académie des Sciences, protested against the abuse of tenotomy and myotomy. With reference to the division of the dorsal muscles, he pronounced the operations of Guèrin in the Hôpital des Enfans Malades, a total failure, rather aggravating than improving the cases. In order to decide between the conflicting reports on the merits of the proposed new treatment of scoliosis, the Academy appointed a committee of inquiry with Roux as its chairman. Guérin could not be persuaded to submit more than one case to the inspection of the committee; but the latter succeeded in collecting twenty-four of his cases. Most of them were not only aggravated by the operation, but some completely disqualified to labor. Thus terminated the delusion of Guérin's muscular retraction, and ever since, his former adherents have been silent on the subject.

Strohmeyer's theory of one-sided paralysis of the respiratory muscles has never been seriously entertained and acted on.

There is yet another hypothesis which ascribes to the disturbance of the equilibrium of the body the cause of scoliosis. There are indeed some facts which seem to sustain that view. The loss of an extremity by amputation; unequal weight on one side of the body; a shorter limb or a malposition of one of the lower extremities, affecting the position of the pelvis, and so forth, unquestionably give rise to a single or double lateral curvature of the spine. You notice this deviation readily when the patient stands or walks.

On assuming a sitting or recumbent posture, at the same time relaxing the contracted muscles, you will notice that the deformity has vanished, and that the spine of the patient is as straight and as perpendicular as that of any other person, but from the constant exercise, much more flexible. We have seen many instances of the usual distortions incident to hip disease, some of them of thirty years standing, and yet there was no permanent scoliosis. From these facts it would appear *that a disturbance of the centre of gravity per se is not sufficient to cause permanent deviation of the spine.*

Thus far the attempt to establish a simple and generally acceptable cause for ALL FORMS of scoliosis, has proven a signal failure. Deficient as our knowledge is with reference to the pathology of lateral curvature, we know this much, that there are different forms of this infirmity, arising from different morbid causes. Thus we know, that rachitis and endostitis may give rise to scoliosis conjointly with kyphosis; that empyema most commonly leaves a moderate lateral deviation of the spine, with flattening of the thorax; and again, that wry-neck is never without more or less curvature of the cervical portion of the spine. But all these and other forms are not the subject of our discourse. On this occasion, we mean to concentrate our attention on that species known by the term of "*scoliosis habitualis*," that being the most frequent and disastrous in its results. As the pathology of this deformity is not as yet clearly established,

* Paris, 1844.

we must content ourselves chiefly with clinical facts, and thus indirectly obtain as clear an insight into its nature as circumstances will permit.

First and foremost, it should be stated, that the beginning of habitual scoliosis is entirely painless; that its development but rarely causes any serious constitutional disturbance; and that a moderate state of health is by no means incompatible with this infirmity. This fact is of significance, because it proves satisfactorily to our mind, that there is no inflammatory or structural disease at the base of the difficulty. For this reason we had to take exception to Lorinser's views, although authenticated by pathological investigation upon the subject. Though we do not dispute the latter, yet we feel justified in opposing the general inferences drawn from them, being in direct opposition to clinical facts.

Suffice it to say, that we never have observed, in connection with scoliosis, any one of those symptoms *denoting a lesion of the spine or any irritation of the spinal cord and its membranes*, except a moderate attenuation of the body, and this only in the higher grades of the deformity.

Nor has any other orthopædic surgeon, to our knowledge, placed on record any observation to the contrary;

2d. Scoliosis has not been traced to traumatic causes, which are apt to produce structural affections of the spine and its adjacent tissues;

3d. Scoliosis does not occur at a period of life at which the spine is easily deranged, either by traumatic or constitutional causes;

4th. Scoliosis occurs much more frequently among girls than among boys, being another evidence against a traumatic cause;

5th, Scoliosis is much oftener the concomitant of wealth than of poperty;

6th. Scoliosis is much more observed among the female population of large cities than in rural districts;

7th. Scoliosis originates most usually at the time of puberty, and in young ladies whose sexual development is protracted, whose menstruation is either imperfect or has not as yet made its appearance; whose condition is feeble from rapid growth and confinement, *and whose spine is endowed with an unusual degree of flexibility.* From this condition we have, however, seen a few exceptions in girls of most unexceptionable constitutional health, strength, and maturity; in whom, however, the deformdity never acquired any great extent;

8th. The boys whom we have seen afflicted with scoliosis, were almost invariably of delicate and florid appearance; tall and thin, with a highly flexible spine;

9th. Scoliosis is remarkably rare among so-called scrofulous individuals; and on the tolerably extensive field of our personal observation, we have scarcely noticed one instance in which the patient manifested symptoms of constitutional affliction.

10th. Although many of our patients affected with scoliosis were, in a moderate degree, asthmatic, yet, we recollect *but one case*, a southern lady of some thirty years of age, that suffered simultaneously from pulmonary phthisis.

11th. Scoliosis prevails in the northern latitudes of the temperate zone, and diminishes toward the tropics.

In summing up these facts, and in excluding from our consideration traumatic and dyserasic causes, and likewise structural changes in the spine, we are reduced to a few points, which prove that *scoliosis bears a close connection to a certain age, to the female sex, its evolution, and a certain general condition of the system and the spine.* In these conditions collectively, lays perhaps, the general pathology of scoliosis, and no author has in our estimation more appreciated them than our late friend Dr. Buehring of Berlin, whose contributions* on the subject are entitled to respect. According to this author, a low state of hæmatosis at that period constitutes the general predisposition to scoliosis, that is to say, a hydræmic or anæmic state of the blood with an inefficient nutrition of the various structures of the body, depriving bones and cartilages of their usual firmness and elasticity, and rendering them susceptible to an alteration of their respective forms. This state of the bones and cartilages, he attributes simply to the poverty of the nutritive fluid, analogous to the blood of the lower animals whose skeletons do not acquire the firmness observed in the higher animals. The softness of the bone is, therefore, the simple result of a low state of nutrition, and not of any specific structural disease, as for instance, rhachitis, osteomalacia, ostitis, etc. Nor is the softness so great as to be affected by the weight of the body

* Die seitliche Rueckgrats—Verkruemmung. Berlin, 1851.

alone, though sufficient to give the spine an unusual degree of flexibility. The next and local predisposition to scoliosis is, according to Buehring, the natural deviation of the spine toward the right side of the thorax, which exists to a slight degree in every individual, being the result of a symetrical weight of the spine by vital organs This view is sustained by accurate measurements of Buehring and others, and are borne out by the fact that in almost all cases of scoliosis the spine deviates in that direction.

To these constitutional and local predispositions, external causes must be added to establish lateral curvature. Buehring charges the use of improper dresses, more especially the wearing of corsets with prejudicial effect. Besides, hard benches, without backs, in school, and the habit of standing on one limb is looked upon as the cause of throwing the spine out of the perpendicular. When this, often merely a bad habit, grows upon the patient without his knowledge, it gives rise to one-sided compression of the vertebral bodies and cartilages by the superincumbent weight, and thus lays the foundation of scoliosis. Thus far the views of Buehring are acceptable and conform with clinical observation. Most authors confirm, that prejudicial habits in gait and position have much to do with the establishment of scoliosis, and this is the reason why this form has been termed *scoliosis habitualis*. But it should be distinctly understood, that these habits alone are not a sufficient cause; superadded to them must be the peculiar condition of the system to which we have adverted,

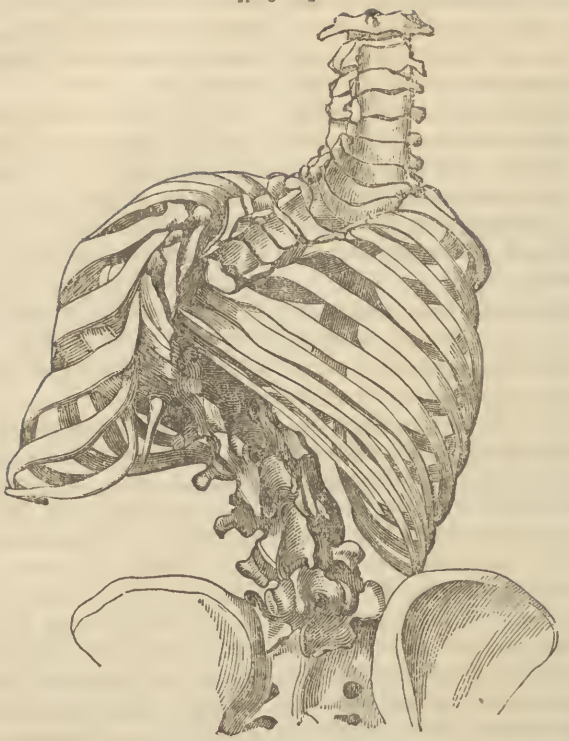
Some writers have ascribed great importance to the principal use of the right arm and right side, but this seems to be an exaggerated notion, since, with few exceptions, everybody prefers the use of the right arm to that of the left, without becoming deformed thereby. Whether the action of the heart in a diagonal direction accounts for the normal deviation in the thoracic portion of the spine toward the right, is open to doubt, since the most powerful cardiac action in hypertrophy and disease of the heart do not materially increase it. A few cases have been recorded in which the heart occupied the opposite position, and the left hand was preferred for use; they are, however, so exceptional in their nature that no safe inference can be drawn from them. On the other hand, deviations of the spine to the left have been observed, in which the patients were right-handed, showing conclusively that the preferment of one or the other hand is of little influence upon scoliosis.

No doubt other causes are operative not sufficiently known nor appreciated. Improper diet and sedentary life, violent dancing and late hours must necessarily tend to enfeeble the constitution and increase the morbid predisposition. In two cases in our charge we ferreted out masturbation as a source of weakness of the system. But the calendar of causes is certainly not exhausted by those we have mentioned, and much will be left to the sagacity and penetration of the attending surgeon.

We have thus delineated to you the condition and causes which in all probability underlie incipient scoliosis. Its progress is hastened by their persistency, and by the deformity itself. You will easily comprehend that after the spine has once lost its perpendicular and its individual vertebral bodies press with superincumbent weight obliquely upon the intervertebral disks and eventually upon each other, the deformity must proportionately advance.

Some experiments of Bonnet and Pommiérs upon the spine, demonstrate in the most direct manner *the great elasticity* of the vertebral bodies. Inflexing the spinal column forcibly, they noticed that the venæ azygos became unusually distended and that on straightening it, those veins collapsed. Since the intervertebral fibro-cartilages possess scarcely any vascularity at all, it is to be inferred that the venous blood was derived from the vertebral bodies which, indeed, have a considerable complement of veins, acting as emissaries between those of the spinal dura mater, and the venæ azygos. Being, however, imbedded in, and protected by the cancellated structure of the vertebral bodies, consequently in a situation where no direct compression can affect the veins, it follows conclusively, that they are simultaneously compressed and relieved with the bodies. These observations are very important for the subject under discussion, and they are well calculated to throw some light upon the proximate cause of scoliosis. For it is self-evident, that as long as the elasticity of the principal constituents of the spine remain intact, there is no physical possibility of the latter becoming permanently deformed, and that gradual loss of that

[Fig. 61.]



elasticity is simultaneous with gradual deviation from the perpendicular. Hence, we find that static deviations of the spine from declivity of the pelvis existing in the second and third stage of morbus coxarius, for instance, have no permanent effect whatever, upon the individual vertebral bodies, the long duration of the deformity notwithstanding, their unimpaired elasticity, being efficient protection. Unfortunately, the otherwise highly instructive investigations of Lorinser in incipient scoliosis, have not been directed upon that point so as to establish the loss of elasticity as the primitive condition beyond further dispute. Yet the facts, elicited by that author, leave scarcely a reasonable doubt as to the elasticity of the vertebral bodies and inter-vertebral disks being materially infringed, inasmuch as he found their shape altered, and their structure impregnated with serum. Beyond the meritorious labors of Lorinser, the stock of our pathological knowledge of the primary changes in scoliosis is rather scanty. The opportunities for post-mortem examinations in the early stage of the trouble are indeed rare. For the deformity steals upon the patient in an insidious manner. It grows slowly, and affords time to the vital organs in accommodating themselves to the altered form of the skeleton. Their functions become but indifferently impeded. The general health suffers but little or not at all, and the patients attain mostly a fair duration of life. We have not become cognizant of a single death induced by scoliosis. And, but in one case we found the diameters of the thorax so much diminished as to affect materially the respiration. The pathologist sees, therefore, only the final anatomical results of scoliosis, and not the initiatory and progressive changes of the spine. With the former we shall now occupy your attention. The diagram before you, (Fig 61), will give a general impression of the disfigurement of the skeleton, in advanced lateral curvature. The height of the trunk is of course diminished in proportion to the deviation, and the extremities appear comparatively too long. At a glance, you notice the alteration of the thorax, which seems to be turned on its longitudinal axis, the convex side of the deformity receding, whereas, the concave side is pushed forward. In looking vertically down upon such a skeleton, the thorax is seen to

be compressed in one diagonal direction, whilst in the other, the distance is materially enhanced. You notice this state in the various plaster casts we have placed before you, and you will find that the difference in the diagonal diameters of the thorax grows with the degree of the deformity. The points of measurement are the nipple on one side, and the apex of the scapula on the other. When considering the details of the curvature we shall have no difficulty to comprehend the mechanism of the morbid form.

In both diagram and casts, a deep and angular impression can be perceived immediately above the ilium at the opposite side of the dorsal curvature, giving an appearance as if the innominate bone had been pushed upward. Rokitanski* holds, that that side of the pelvis stands *actually* higher. We believe this to be an error. For if it was so, limping of the patient would be inevitable, of which we have not seen a single instance. The fact is, that the false ribs of that side approximate the ilium closely, sometimes overlapping on the inside. If you place the patient in the erect or recumbent posture, you will find the anterior superior processes of both ilia, the larger trochanters, the patellæ and the malleoli in corresponding position, precluding obliquity of the pelvis.

The same author speaks likewise of a distortion of the pelvis, caused by the twisting of the os sacrum. Merkel has never observed it. If the pelvis is thus altered in its symmetry, it is certainly of no great account, since parturition is scarcely ever impeded. All we have observed in this respect, is a moderate projection of the promontory, scarcely enough, however, to diminish in a material degree the superior aperture of the true pelvis.

In most cases of scoliosis there is, besides the lateral deviation of the spinal column, a torsion of the same, to the effect that the vertebral bodies are turned toward the convexity, and the spinous process toward the concavity of the curvature. The torsion is greatest at the most prominent part of the deformity, and diminishes in reverse ratio toward the beginning of the arch. In analyzing the details of the curvature, we notice:

1. That all the vertebral bodies implicated in the deformity have lost in height at the incurvation which gives them a wedge-like shape. The alteration of their form corresponds with the degree of the curvature. In very aggravated cases, the superior margin almost reaches the inferior one. In cases not so far advanced, the body recedes between the two projecting margins, clearly proving, that the superincumbent compression is the cause of alteration of the shape.

2d. A similar deformity of the inter-vertebral fibro-cartilages, which at the concave side becomes so lowered that the vertebral bodies touch each other, and become facetted by friction, (usor.) In such cases osteophytes spring up immovably connecting the respective vertebral bodies. The cause of these osteophytes is to be ascribed to the usor, and perhaps likewise to the unavoidable irritation of the adjoining periosteum.

3d. The oblique processes at the concavity atrophied, sometimes elongated and flattened, not rarely anchylosed.

4th. The ribs at the concavity flattened like a band, and strongly bent forward at their angle with diminished arches. Their deformity is sometimes so great as not only to diminish the convexity of the thorax, but even to cause a caving in. Not rarely they are anchylosed with the vertebral bodies and transverse processes. Moreover, they not only approximate *each other*, but also the ilium. The ribs at the convex side are more angular and narrower than their normal form implies. In following the torsion of the spine and strongly bending at their arch, a considerable projection is thereby produced, that lifts off and upward the scapula, together with which they form a lateral hunchback, not to be concealed by any mode of dressing or wadding. In contrast with the other side, the ribs separate more from each other, which widens the space within the right side of the chest.

5th. The sternum being drawn at its lower end downward and toward the left, partly out of the median line.

6th. The dorsal muscles in a state of fatty degeneration, soft and pale, their insertions drawn under at the convex side and *vice versa*.

Most usually there is a double curvature, one comprising the dorsal, the other the lumbar vertebræ; in some instances, we find but one large curvature; in others three and even four. In the latter case, the cervical vertebræ are implicated. As yet it has not been clearly

* Lehrbuch der Pathologis. Achennatomie, Band 2, p. 170.

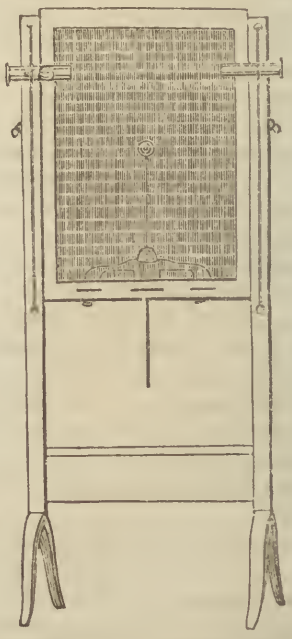
ascertained which of the curvatures is the primary and which the consecutive deformity. Most likely the difference of causes produces in one instance the lumbar deformity primarily, and vice versa. The consecutive curvature is known by the term of the compensating deformity. When the double curvatures are properly compensated by each other, the shoulders occupy the same position, whereas in single curvature, the shoulder at the convex side stands higher. As already remarked on a previous occasion, the dorsal curvature is with few exceptions constantly toward the right, and the lumbar toward the left. The cause of this regularity cannot be ascertained on the subject. That the aorta follows the course of the deformed spine is self-evident.

The diagnosis of scoliosis habitualis meets with no difficulty. In incipient cases, a plummet line suspended from the spinous process of the 7th cervical vertebra will show the slightest deviation from the perpendicular. In advanced cases, eye and hands will suffice. Some difficulty is however experienced in ascertaining the changes which the deformity may undergo during the treatment, either for better or worse. And as this is of importance we will acquaint you with the best method to define such changes.

Formerly plaster casts of the trunk were taken from time to time, and their respective differences determined by comparison. This method is, however, deceptive. For, in order to take a mould of the trunk, the patient has to be placed in a horizontal position, which of course relieves the spine of its superincumbent weight. As long as the spinal column has retained a part of, or its entire abnormal flexibility, it will almost be impossible to get a true copy of the exact deviation which the patient presents in the erect posture. Per accident we may obtain a representation greater or less than the exact deformity. Pretenders avail themselves of this circumstance for the purpose of deluding their patients, by artificially aggravating the deformity for the first mould, and take good care to get better forms for the subsequent ones.

In advanced cases of scoliosis, the plaster casts become more truthful, and therefore more reliable representations, because the flexibility of the spine has generally become extinct, the deformity more stable, and all the anatomical parts concerned in the same have assumed a more permanent shape. But even in these, deception may be practiced by placing one side higher than the other. In order to obviate possible error, Dr. Buehring has introduced a very ingenious contrivance, by means of which the contours of the form can be accurately taken in an expeditious manner. The principal part of the apparatus is a glass plate, sixteen inches by twenty in size, the frame of which is moveable on an erect scaffold. The glass plate is divided by lines in half square inches. From the centre of the upper part of the frame a plummet line is suspended. At the side of the scaffold a contrivance is affixed, designed to grasp around the arms of the patient below the insertion of the deltoid muscle, and at the lower part of the frame a horizontal projection is placed, upon which a movable dioptor is fixed upon a vertical staff. You see the apparatus in all its parts and simplicity before you, (Fig. 62), and we shall now proceed to exemplify its practical usefulness. In placing the apparatus with its dioptor toward the light, and the patient behind it, you have then to adjust the glass plate so as to cover the entire trunk. Next you fasten the arms of the patient to the scaffold, and to render him there by immovable, you take care that the patient stands with his spine in the median line of the plate as straight as possible, and with his heels together. By means of a delicate camel's

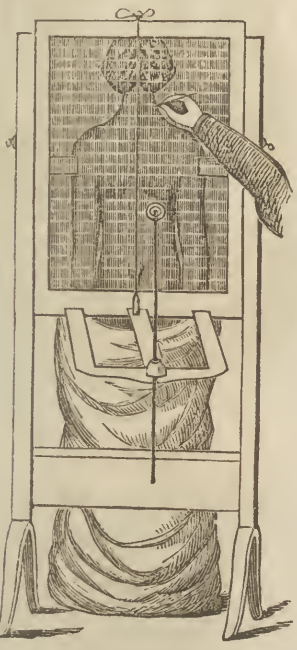
Fig. 62.



hair brush and some paint, you draw the lines of his contours accurately upon the glass; lastly, you suspend the plummet line corresponding with the spinous process of the 7th cervical vertebra, and by means of the dioptor the curved line of the spine and its deviation from the plummet line can be accurately marked.

After the patient has been released from his position, you place a sufficiently large sheet of paper on the plate, and trace the lines of the body thereon. In this simple manner (Fig. 63,) you can

Fig. 63.

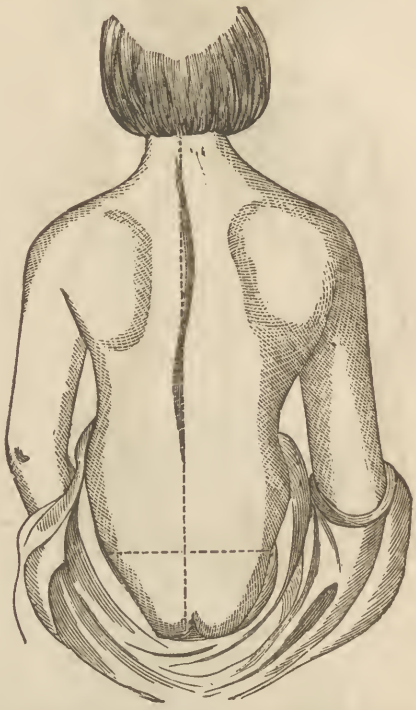


procure at any time, and as often as you deem necessary, the existing deviation of the spine, and compare it with the preceding representations, and thereby relieve your patients, not only of a material expense, but likewise from exposure to menial hands.

Some authors, Buehring among them, discriminate several degrees of scoliosis. Inasmuch as the differences are not qualified by pathological changes, their scientific value is rather questionable; yet, designating the incipient or more advanced stages of a continuous infirmity, they may be admissible as conventional expedients, and as such we bring them before you.

The first degree (Buehring,) manifests itself as an exception of the *normal* lateral curves, that is to say, the thoracic portion of the spine inclines more to the right, whereas the lumbar portion may be unchanged or slightly deviate to the left. On Fig. 64. you have an exemplification of the

Fig. 64.



first degree. The perpendicular is indicated by a dotted line traversing the transverse diameter of the pelvis. The tension of the thoracic curve is about 2‴; the lumbar curve is not noticeable. The plummet line passes on the left of the rima natum, notwithstanding that the spine has almost entirely preserved its perpendicular. There are not as yet secondary deformities of the trunk, and the hand can easily detect the curvature.

In the second degree, as represented in Fig. 65, and in this cast of a young lady, (Fig. 66,) the trunk manifestly inclines toward the right; the plummet line passes an inch to the right of the median line of the sacrum; the tension of both thoracic and lumbar curves are marked; the shoulder blades have already changed their relative positions and the ilium is more prominent. There is, however, as yet, no torsion of spine, nor are there permanent changes in its anatomical constituents. By means of the hand, or suspension of the patient in Glisson's swing, the curvature can be corrected; the flexibility of the spine is consequently still preserved.

Fig. 65.

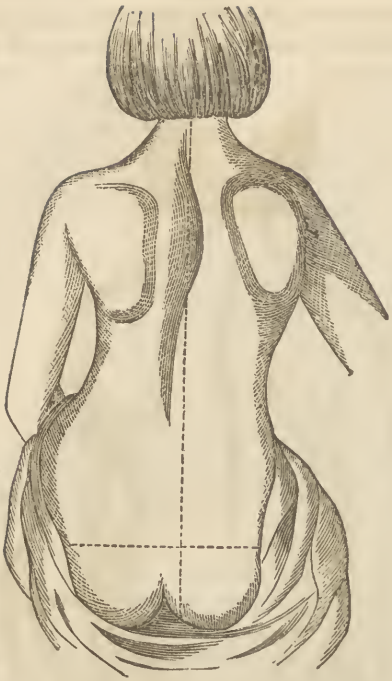


Fig. 66.

Fig. 67.

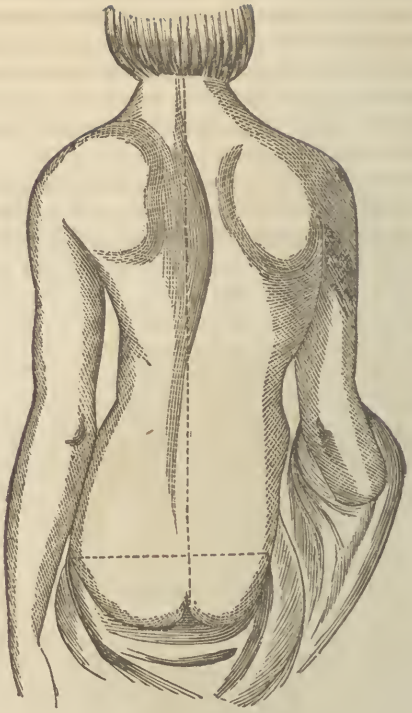


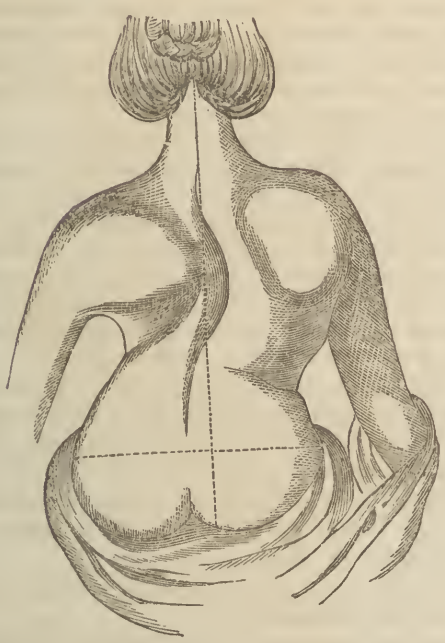
Fig. 68.

The third degree (Figs. 67, 68,) is already characterized by anatomical changes and various consecutive deformities concerning the trunk. The latter, it will be perceived, does not incline as much to one side as the second degree, owing to the proportionate compensation through the lumbar curve, yet the contours of the thorax are materially altered, the respective angles of the right ribs are lessened and in degree more prominent, in consequence of which the shoulder-blade has been displaced at its lower angle and assumed an oblique position; whereas, in front the ribs recede from the sternum and are flattened. The articulations of the vertebræ are rigid, almost anchylosed, and the most powerful extension fails to correct the curvatures.

The fourth degree represents the final result of progressive scoliosis habitualis, beyond which there can scarcely be a greater aggravation.

Fig. 69 shows the appearance of the preceding diagrams, but more extended. The anatomical character we have brought under your notice under the pathological head to which we refer you.

Fig. 69.



Figs. 70, 71, 72, represent cases from our own practice; Fig. 72, being the front view of the preceding.

Fig. 70.

Fig. 71.

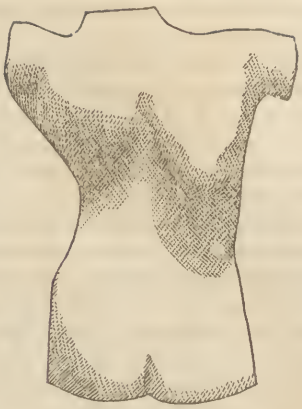


Fig. 72.

As regards the prognosis of lateral curvature, we have to take our guidance from both clinical experience and pathological anatomy.

As long as the flexibility of the spine exists, and the hand or mechanical means are still effective in correcting the deviation, there is possibility in diminishing or even removing the trouble by a proper and persistant treatment. The results of your effort depends, however, to a considerable extent, upon the patient. With her faithful co-operation alone, you can count on reasonable success, and hence, the character of your patient should be embraced in your prognostic calculations.

The third and fourth degrees of scoliosis are positively precluded from amelioration, for reasons which we need not detail. All you may accomplish in the third degree is to check its advance by appropriate means.

Treatment.—Gentlemen: On entering upon this rather difficult subject, we shall briefly discuss the means of preventing scoliosis.

Believing, as we do, that the predisposition of that deformity rests with some defects in the sexual development of the patient, affecting, and eventually impoverishing the nutrition, preventive efforts should be made in that direction. The patient should not only be protected against influences likely to depreciate the physical standard of her constitution, but measures should be adopted to enhance its vigor, and thus fortify the frame against distortion. The faithful observance of the laws of physiological hygiene will mostly accomplish the object, medication being scarcely ever called for. Hence, the patient should live regularly and generously and abstain entirely from knick-knacks; should neither indulge in lascivious habits nor exhaust the physical powers by over-exertion; should alternate in proper proportion between rest and locomotion; wear comfortable dresses alike protective against cold and over-heating; prefer physical and domestic to sedentary employment and over-taxing of the mind; in fine, live for a period of a year or more for physical well-being alone, until puberty with its attributes has become fairly established, when the intellectual training may be resumed without hazard. In this simple but effectual way we shall safely carry young females through a dangerous period of their lives, and qualify them for their exalted mission.

With these Lycurgian rules we may come in conflict with the established habits and notions of high-life, yet there can be no compromise between right and wrong, between reason and folly. Irrational indulgence precludes the possibility of robust constitutions, and consequently, of healthful enjoyment. In the same ratio as the system is depreciating, the mind suffers—"Mens sana in corpore saño."

When on examination of your patient, you notice undue flexibility of the spine, you may at once set it down as the virtual commencement of scoliosis, and take prompt measures to avert the impending deformity. In order to realize the danger, you need but to place the patient in the erect posture and raise one of the lower extremities from the floor by a piece of board or book; the spine is at once thrown out of its perpendicular, presenting lateral curves of great tension. Such a condition is inseparable from general debility and languor; hence, prejudicial habits grow easily out of the want of support, and determine permanent deviation. It is extremely rare, however, that we are called upon for advice at that juncture; we find mostly already the commencement of actual scoliosis, or the so-called *first degree of Buehring*.

In treating this stage, the most scrupulous hygiene should be insisted on, and eventually remedies administered with a view to regulate and tonify the general system. Country residence or mountain air, cold bathing and animal diet are commendable auxiliaries.

A system of diversified physical exercise should be adopted and discreetly persevered in, by which *gait and posture constantly alternate and change. It is most assuredly the best protector against prejudicial habits, and the best remedy to correct them.* Without going into superfluous details, some general rules should be laid down in the adoption of gymnastic exercises, otherwise, and if promiscuously indulged in, they might do more harm than good.

1. The exercises should, if possible, be taken in the open air, so as to obviate over-heating of the body, and to sustain respiration with a proper alimentary supply.

2. The exercises should tax the entire muscular system at once or successively, and not exempt one part or the other.

3. The exercises should preclude vertical pressure upon the spine.

4. They should be moderate and discreet, so as not to exhaust the physical strength.

5. They should alternate with rest in the recumbent posture upon a firm mattrass or lounge.

If the spine is already deviating from the perpendicular, *active exercises cannot be practiced to a great extent without injury to the patient.* The "antiplastic" movements of Werner commend themselves as excellent substitutes for active exercises. The patient is placed upon a covered table in a dorsal position; the hands of the operator are employed to correct the deformity and to bend the spine over in the opposite direction; and, in fine, the patient directed to maintain the same by will for an hour or so at the time. Another competent person may take the place of the physician to facilitate proceedings, which should be repeated several times during each day. Or a movable footboard for the left limb may be adopted in substitution of the hand, which, in raising the left side of the pelvis reverses the deviations. Aromatic frictions of the back and kneeding of the dorsal muscles and cold douche are remedial additions.

The treatment of incipient scoliosis thus delineated, will effectually meet the indications presented, and if systematically persevered in, give substantial relief to the patient. Mechanical support or orthopædic beds, we deem dispensable for the first period. But if the patient should be so situated as not to be able to devote much time to the treatment, then, and only then, it may be expedient to provide a spinal supporter for day use. Of its proper construction we shall speak in our next lecture.

In the second stage of scoliosis, the local treatment of the deviating spinal column comprises the chief object of our attention, whilst the general management of the case remains the same as previously stated. You recollect that the deformity has already assumed a decided character, and its consecutive effects begin to show themselves upon the thorax. However, there are as yet no alterations in the shape of the individual vertebræ, nor has the tortion of the spine made its appearance. By mechanical means the spinal column can be brought into a perpendicular direction. The scoliosis depends perhaps exclusively on the lessened elasticity of the inter-vertebral fibro-cartilages.

In dealing with the second stage, the question presents itself: whether it would be wise to allow the patient the erect posture and locomotion, or whether it would be better and more appropriate to direct the recumbent one. The former have their advantages which cannot be denied. They enable the patient to gratify the natural taste for change; to exercise the muscular system and procure better air than confinement to the bed would afford. But it should be borne in mind that the spine is already thrown out of its perpendicular; that the superincumbent weight acts upon it to great mechanical disadvantage, and that teh patient is likewise permitted to perpetuate the old habits of prejudicial gait and attitude. It would seem as if there could be no conciliation between active exercises and arrest of scoliosis, that we had to relinquish the one or the other. Hence we cannot hesitate in accepting the recumbent posture as the better of the two, for thereby we get rid of superincumbent weight and bad habits. As we have already mentioned, the fear of confinement is certainly exaggerated if found at all in clinical observation. Rest may be endured for some length of time with benefit at least to the muscular system, whilst the wear and tear of the body is decreased and the character of nutrition enhanced. The alleged bad effects of confinement refer only to the excess of the same, and the physician has it in his power to curtail it should it operate injuriously upon the constitution. Although it might be better to remain on a firm mattrass in a stereotype position, yet in order to relieve its irksomeness, a change of the bed with a couch, or a well-reclining arm-chair, as, for instance, that of Mr. King, in Broadway, New York, might well be conceded to the comfort of the patient. Nor would there be any reasonable objection to raise the bed into an inclined plane, so as to enable the patient to read or look about. Thus by ingenious contrivance some orthopædic surgeons have succeeded in constructing apparatus, combining with the recumbent position, facilities for the pursuit of music, writing, drawing, and reading, without the slightest inconvenience or fatigue. Education may thus be carried on without interruption, as long as it is compatible with the objects of the treatment.

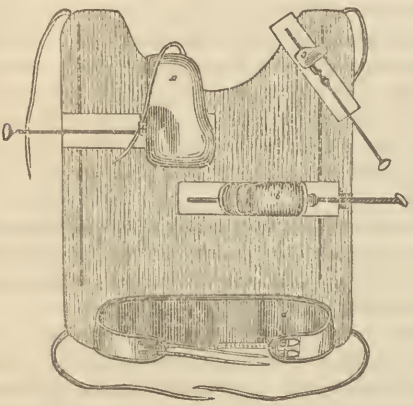
The antiplastic movements of Werner may be tried to reverse the position of the spine, but we apprehend that in most cases they will be found insufficient.

In former times, the so-called orthopædic beds were employed to overcome the deformity. Their chief design was longitudinal extension; some of them combined pressure upon the convex portions of the spine. The construction of those beds, of which a great variety has been introduced into orthopædic practice, bear great semblance. A belt for the pelvis is connected by straps with a cogwheel at the foot of the bed, and an appropriate apparatus for the head with the opposite part of the bed. After the patient has placed herself upon the bed, belt and headpiece are adjusted and the extension made by means of the cogwheel. For the sake of lateral pressure, either cushions or wedge-formed pads were brought to bear upon the spine. During a long period the mechanical bed was the only remedy in vogue against scoliosis, and great ingenuity has been employed in its construction. Its unsatisfactory results were of course ascribed to the deficiency of its mechanical arrangements and not to the invested principle. Thus changes in the construction and improvements were carried on until Guerin* and Major put a stop to them by demonstrating *that longitudinal extension was a failure, unless accomplished by direct action upon the curvatures.* Since then mechanical ingenuity has been thrown into a new channel with a view of constructing apparatus acting by lateral pressure and counter-pressure.

* Rapport, addressé a Monsieur le Dolégué du Gouvernement provisior, etc. Paris, 1848.

The contrivances of Guerin and Major are very complicated and costly, yet they fulfil the object of simple and double lateral action, and may therefore answer in the second stage of scoliosis, which is not as yet complicated with torsion of the spine or an obliqne shifting of the thorax. In the latter stages, they are, however, inefficient, and unable to realize the presented indications. Bnehring's reduction-apparatus, which we hereby submit to your inspection, is for many reasons a

Fig. 73.



superior contrivance, (fig. 73,) and we have found it in onr practice a most serviceable instrument. It is not only simple, compendious, and applicable to an ordinary bed, bnt you may render it useful to all stages of lateral cnrvature. Its cost is but trifling when compared with those of Guerin or Major.

The pattern before you is designed for the third stage; we shall, however, show you how to convert it into an effectual apparatus for the second stage also.

You perceive that Bnehring's apparatus consists in,

1st. A plate of sheet iron, covered with ticking, or any other suitable material, to prevent the cold contact with the metal and soiling of the bed with rnst. At its upper portion a sufficiently large piece is taken out for the neck, although this is immaterial. But the iron should be sufficiently strong so as to prevent bending. Parallel with the edges and about two inches from them a longitudinal fissure is made, sufficiently wide to admit a one-sixth of an inch screw moving to and fro.

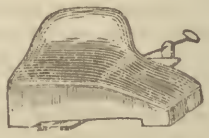
2d. A well bolstered belt, made of a steel spring, to be buckled in front.

3d. Three movable parts of well-bolstered soft wood, one for each deformity, and one to raise the left arm. In taking a profile view of these parts, you observe the thickness of the two former, whereas the third is rounded and long enongh to exceed the axillary cavity. They are movably fixed npon iron frames, and set in motion by a screw. The modus operandi is plain. When attached to the iron plate yon can give them any position to the body you choose, and whilst the patient is fastened in the belt and the pelvis thus rendered immovable, you screw the pads against the spinons processes, and gradually press them over in the reverse position. The transverse processes rest upon the pads. In proportion to the thickness of the pads, the body is elevated from the iron plate, and the weight of the same is thns made use of to tnrn the spine on its longitndinal axis in the opposite direction from that we first fixed it in. The lower the wooden blocks the less we can connt on that action, and in substitnting a plain pad of iron, we rednce it to a simple lateral shifting, and thns render the apparatus serviceable for the second stage.

Fig. 74.

The pad for the lnmbar deformity (fig. 74) is bnt narrow, but it shonld be large enough to embrace the side of the body. The pad designed for the thoracic cnrvature is of much larger size in order to cover the protrnding ribs and shoulder blade, being, of course, in keeping with the proportions of the patient. Its exact form in the

Fig. 75.



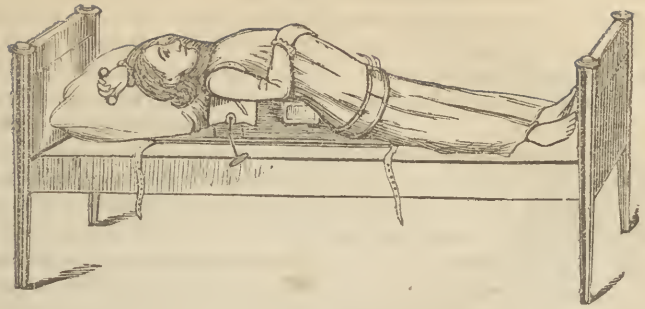
apparatus should be noted by you (fig. 75) for

Fig. 76.

future use. The pad for the left axillary fossa is an erect piece of wood, ronnded and well-covered. (fig. 76.)

In this diagram, (figure 77,) you observe the patient in position on the apparatus. The latter is fastened to the bed by straps. The pads

Fig. 77.



are adjusted and the belt buckled. The limbs are free for exercise. In appearance we have a Procrustean bed, and can scarcely conceive how a patient can endure the same for any length of time. And so it seems to be in the first days of its use. But the patient becomes soon used to it, and in time it actually becomes indispensable to his comfort, so that he prefers it to a luxuriant mattress.

The efficacy of this contrivance is great. When discreetly applied and attentively managed, Buehring's Reduction-Apparatus is capable of effecting such changes in the form of the spine as no other construction of this kind. In our humble opinion it is at present the best known, and is deserving of your adoption.

The length of time a patient should continue in the recumbent position depends, of course, on the individuality of the case, and cannot well be fixed *à priori*. As a general rule you are to discontinue the recumbent posture, when the morbid flexibility of the spine has subsided, the deformity is reduced, and when in the erect position the spine shows no further tendency to deviate from the perpendicular. In some instances this result may be accomplished in a few months, in others even a year, or more time may be required. The improvements of the deformity advance conjointly with the growing constitutional strength, for as long as the general system remains in a debilitated state, the undue flexibility will likewise perpetuate its existence. If the patient should be necessitated to interrupt the treatment, we must then content ourselves with the use of the apparatus during the night, and provide a spinal supporter for day use. The same should be done with convalescents to avert relapse.

The history of spinal supporters is the same as we have mentioned with reference to the orthopædic bed. They were originally rude, and constructed for longitudinal extension. The head was suspended by a steel spring, ascending on the back from the belt and fastened to the upper extremities. Hossard was the first who constructed a spinal supporter on the principle of lateral pressure and counter pressure. (fig. 78.) Tavernier*

Fig. 78.

speaks of its efficacy in high terms of approval. Nevertheless, Hossard's Inclination-belt has fallen into disuse by subsequent improvements. To enumerate all the inventions in this line would be an ungrateful task, and scarcely realize the value of our time. All of them can be reduced to the same principle of lateral counter-pressure, to which the support of the arms is added. We beg to lay down the rules for the proper construction of the like apparatus.

1st. An accurate cast of Plaster of Paris taken of the patient is indispensably necessary to give to the supporter *a perfect fit*.

* Notice sur le traitment des difformités de la taille ou moyen de la ceinture sans lits à extension ne bequillas. 1841.

2d. The pelvic belt being *the mechanical foundation of the apparatus*, should be most accurately adapted to the pelvis, according to the suggestions made on a former occasion. Most instruments are deficient in this point and lose their usefulness in proportion, however ingeniously constructed otherwise.

3d. Two pads intended to support or press upon the deviated portions of the spine and ribs. They should not only fit well, but likewise move on their respective supporters, so as to remain in place though the body may alter its position.

4. The brace, or braces, for the pads should be adapted to the deviation of the spine and to the form of the trunk in general.

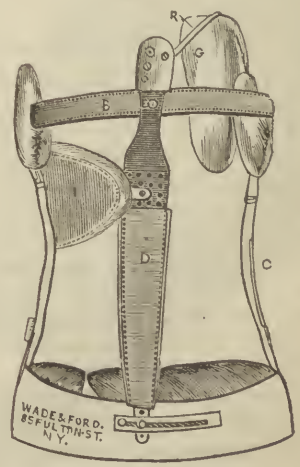
Some surgeons give the braces the elasticity of a spring, others move them by endless screws, but most make them stationary. The last mode we prefer, as it does not interfere with the stability of the apparatus. To act by a sufficient pressure, so as to diminish the tension of the curvatures, whether by springs or endless screws, seems to be utterly impracticable. At any rate, we have observed that it affects only the position of the belt and not the deformity itself, more especially if but one pad is set in operation. The reason is plain. For either spring or endless screw, you require a firm point from whence they act, which the belt cannot afford. The resistance to be overcome by such action, is conjointly effected by the superincumbent weight of the body and the deviation of the spine, against which the best adjustment and the greatest possible solidity of the belt is no mechanical counterpoise.

All we may reasonably expect from a spinal supporter is to prevent the progress of the deformity, and retain the same in *statu quo*. Our esteemed friend Barnhard Brodhurst, Esq., the studious and talented surgeon of the Royal Orthopædic Hospital, of London, has recently suggested a spinal apparatus * with a view of accomplishing thereby radical relief from scoliosis. He gives the following description of the same:† "The instrument, to which I desire to direct attention, consists of a frame and a lever, and loops upon it. The frame is formed of a pelvic hoop (belt), of crutches springing from it, and rising to the axillæ, and of a connecting dorsal band, which uniting the crutches, is placed at the superior extremity of the primary curve. This forms a frame which cannot tilt. The crutches are made to lengthen, and the dorsal band is also movable, so that together or separately they may be raised as the curve is opened. Upon the centre of the dorsal band a lever moves on its axis. It is moved by means of a long screw, which is attached to the pelvic hoop and rising to the top of the shoulder is connected to the shoulder sling or loop. This shoulder sling is formed of a ring of gutta percha, it is accurately moulded to the shoulder, and lies upon the clavicle, the scapula, and the superior ribs beneath the axilla. It is placed on the shoulder, which corresponds to the concavity of the primary curve. The convexity is supported by a large pad, which embraces all the ribs that are connected with the vertebral curve. This pad is attached to the lever by a short arm which may be shortened as the curve is opened."

Brodhurst relates some cases successfully treated by the apparatus and exemplifies the amount of relief by diagrams taken from life. At first sight it seems almost incredible that a radical cure could be achieved in the erect posture and by so slender means as the lever and the shoulder hoops. Yet Brodhurst is an accurate observer, and a truthful recorder of facts. Without deliberate reflection and diligent test, no doubt should be attached to his statement. We therefore deem it but proper to enter on this occasion into a careful criticism of Brodhurst's spinal apparatus, for which so important qualities are claimed by its inventor. With laudable modesty Brodhurst acknowledges his indebtedness to Guerin and Lonsdale for the idea of unbending spinal curves; to Mr. Evrard he accords his share in the construction.

Now, gentlemen, in placing this apparatus (fig. 79) before you, it may seem as if it did not differ

Fig. 79.



* On Lateral Curvature of the Spine. London John Churchill.

† Page 54. *Ib.*

from the usual spinal supporters. A closer inspection can not, however, fail to arrest your attention with reference to some material modifications and alterations of the usual type.

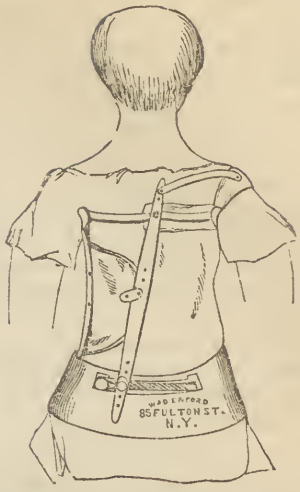
There is the belt, the pad, and the crutches, as in others. You notice, however, that the crutches are connected with a cross-band which gives an unusual degree of firmness to the apparatus. Again, whilst in most others, the dorsal brace is stationary, the lever in Brodhurst's instrument moves on a pivot with great power, actuating simultaneously the pad and shoulder-hoop, and thus operating in opposite directions. Whilst, therefore, the pad is brought to bear upon the dorsal curve through the ribs, the opposite shoulder is lifted and drawn to the other side, by which the weight of the spine is changed in the opposite direction. The modus operandi of the instrument is therefore equal to the antiplastic movement of Werner, which in fact it renders permanent.

From the value which we have attached to the antiplastic manipulation of the latter, you may infer our estimation of the practical utility of the apparatus. But in order not to overrate its serviceability, you should bear in mind, that it can only affect the curves as long as the spine has retained its flexibility.

We have had occasion to employ the apparatus in some incipient cases of scoliosis and can bear testimony to its practical value. This diagram (fig. 80.) exemplifies its application upon a patient.

In the third degree of scoliosis, the extent and character of the deformity admit of but slender hope for improvement, if any. Our therapeutical object is to re-establish flexibility of the spine and mobility of the ribs by all the means at our command. For if the interested portion of the skeleton is unchangeably fixed, no alteration of curvature can be effected.

Fig 80.



For this purpose we employ Buehring's reduction apparatus, during night and day; use powerful frictions of the back with phosphorated oil, apply a strong current of galvanism in order to invigorate the degenerating muscles and resort likewise to the antiplastic manipulations of Werner. If we succeed in rendering the spine and ribs again moveable, we treat the case as advised under the previous degree. Should, however, the case resist all our persistent efforts, then it may be advisable to prevent its advancement by an appropriate spinal supporter.

A completely confirmed scoliosis with anchylosis of costal articulations and the intervertebral union is equally unsusceptible to amendment or advancement.

The fourth degree is therefore, and in a therapeutical point of view, "*noli me tangere.*"

V.—DEFORMITIES OF THE NECK.

The cervical region is likewise subject to deformities. In most of them the head is temporarily or permanently drawn out of its perpendicular. Extensive burns bring about such results. Inflammation of the spinal apparatus and its pathological consequences disturb more or less the position of the head. Next, there happens a congenital deformity of the neck known by the term of wryneck—obstipitas capitis, or torticollis. And lastly, convulsive aff ctions of the cervical muscles occur, commonly emanating from some affection of the spinal cord, which incessantly disturb the symmetry and position.

The two former we have already discussed on a prior occasion. We shall therefore limit our remarks to the two latter.

Wryneck—[Torticollis.]

This deformity is commonly of congenital origin, and consists of a permanent contraction of either of the sterno-mastoid muscles. We have seen but two instances of contraction of both those muscles, but had reason to believe them to be acquired by resp. inflammation of the cellular and muscular structures themselves, and that of the cervical portion of the spine. The latter, observed in a boy of 14 years, the spondylitis had entirely subsided but the consecutive muscular retraction had remained. In one case the scaleni muscles on one side were concerned in the deformity, and the sterno-mastoid free from contraction. And in quite a number of cases only the clavicular portion of the latter was implicated.

In the ordinary species of torticollis we have therefore to look upon the contraction of a single sterno-mastoid muscle as the proximate cause of the trouble, but know very little about its remote causation.

From analogy we may infer that morbid centrifugal innervation lies at the bottom, and we find therefore simultaneously other symptoms of kindred nature, as for instance, congenital strabismus, and the characteristic attenuation to the extent of the nervous province concerned.

In high graded cases of torticollis the deformity is very considerable and extends to the spine and the thorax.

The little girl which we operated upon in your presence to-day, cannot be set down as an aggravated case. She was too young for that. It is with torticollis as with clubfoot, age renders them worse. The diagram (fig. 81,) represents a further advanced state of wryneck, and you notice its effects upon the frame.

Fig. 81.

First, it may be seen that the points of insertion of the right sterno-mastoid muscle approximate each other, and its tensity is exhibited by the prominence of its attenuated belly. The right side of the head is thereby drawn forward and toward the shoulder. The face is turned left, and the chin stands above the left side of the thorax. The right side of the face and neck is obviously atrophied, and the line of the palpebral margins slanting from the left to the right. The thorax seems to be, and actually is twisted on its axis from left to right, and lifted upward. If you fix the thorax of such a patient and attempt to turn the head in the opposite direction, the contracted muscle becomes still more prominent and the patient experiences keen pains. And on the other hand, if the patient occupies the recumbent position, and the head is suffered to be placed on a level with the trunk, the thorax is drawn up and to the right, causing considerable and often so intense pain as to disturb the rest of the patient. In this way, we presume, the torsion of the thorax is effected, and in order to obviate this aggravation, the head should be well supported during sleep so as to relax the retracted muscle.

In viewing the same patient posteriorly (fig. 82,) you can readily observe that the spine has assumed a serpentine line, being laterally convex on the left of the cervical, on the right of the thoracic, and not seldom again convex on the left of the lumbar portion of the spine. Sometimes there is but a single lateral curvature, comprising the two upper

Fig. 82.

thirds of the entire spine, with corresponding elevation of the scapula and ribs of the convex side. These indeed inevitable deviations of the spine and the thorax disappear with the wryneck, and thus demonstrate again the correctness of our former observation, viz.: that a specifically mechanical disturbance of the centre of gravity cannot exercise any lasting effects upon the perpendicular of the spine.

The essential symptoms of wryneck are about the same, whether occasioned by contraction of the sterno-mastoid or one or the other of the scaleni muscles. From a comparison of the relative power and leverage of those muscles, it is obvious that the degree of torticollis must be greater when the sterno-mastoid muscle is the seat of the difficulty.

As an usual thing, wryneck is both congenital and permanent. This rule is, however, not without its exception. Inflammation of one of the sterno-mastoids, or any other of the rotatory and flexor muscles of the head will, at least temporarily, give rise to symptomatic torticollis; and affections of the cervical portions of the spinal cord is occasionally ushered in by the same symptoms. We mention those instances merely as points of theoretical interest, but inasmuch as their treatment lies in a very different direction from the ordinary form of wryneck we do not intend to occupy your time at this juncture.

If both sterno mastoids, or the scaleni muscles on both sides, are shortened, the head is of course directly inclined. That deformity cannot be properly termed torticollis, nor double wryneck, as has been suggested. Inclination of the head would seem preferable.

The *prognosis* of common torticollis is favorable. Ever since the introduction of tenotomy, that deformity has been manageable. Nor are the consecutive effects of torticollis formidable obstacles to perfect restoration of the normal form; at least we have found them so in our practice. In advanced cases of long standing, the spinal deformity may possibly have become so rigid as to admit of no material amelioration, but such instances are exceptions from the prevailing rule.

The *treatment* of wryneck is either mechanical or operative, or both conjointly.

The mechanical treatment is admitted only in very slight cases of torticollis; it requires a long time to accomplish but little, and is generally too inefficient to be exclusively relied upon. Yet we have succeeded in two cases, and in a third that is now under our charge we hope likewise to succeed. The last we take occasion to exhibit to you. You perceive that the head of the little patient deviates but moderately, and that with some aid we have no difficulty to give it its normal position. But that habit has nothing to do with the existing deformity, can be readily demonstrated by the retraction of the right sterno-mastoid muscle being well marked, though not a very powerful one. Moreover, her parents assure us that the deformity has been observable since her earliest infancy. And since there are no local conditions to account for the trouble, we may safely assume its congenital origin.

Previous to the introduction of tenotomy, when mechanical contrivances had to be exclusively relied on in the treatment of torticollis, many contrivances were suggested to meet the exigency. The needed mechanical assistance is, however, so simple, that we may safely dispense with the old harness. Thus, for instance, if you intend to apply extension, you may use an ordinary bed in the place of the costly orthopædic one. Stout adhesive plaster may be chosen in the place of leather belts and straps, and india rubber rings take the place of steel springs.

By a well-fitting body fastened to the bedstead, the counter extension may be effected; the head drawn in the opposite direction by an appropriately cut and applied strip of stout adhesive plaster, and affixed by means of india rubber to a hook. That constitutes all your requirements.

But if you propose extension whilst the patient sits on a chair, you have to fasten a rod of well

tempered iron to the back of the chair, bending like a helmet over the head of the patient, to which the plaster may be attached as to the bedhook. Or a similar contrivance may be joined to an ordinary dorsal supporter for posterior curvature of the spine, which would enable the patient to indulge in any posture he likes, inclusive of locomotion. We have, however, rarely resorted to those means even, inasmuch as a high and stiff leather necktie, as Dieffenbach usually preferred, answered every demand.

In finding the retraction too obstinate for extension, tenotomy is next in order. Practitioners not well acquainted with the help derived from the position of the patient and efficient assistance, evince a good deal of timorousness when called upon to divide the sterno-mastoid muscle. Indeed, the anatomical importance of the parts located near the field of the operative proceeding, and the apprehended danger of their injury, is quite enough to give tremor to the inexperienced hand. But, gentlemen, there is no real danger if you proceed with proper caution, and observe the advice we have offered repeatedly, viz.: *to raise the contracted muscle from its subjacent parts by proper extension.* When you last witnessed the operation at our clinic you will remember that we directed one of our assistants to fix the thorax well by placing his hands over the latter in such a manner as to embrace the shoulders, resisting at the same time the pull at the head; whereas, the second assistant had to draw the head and likewise to rotate it against the action of the retracted muscle. In doing so the muscle presented itself as a strong and tense cord, which could be easily circumvented by the finger. Thus you isolate the muscle and you meet with no obstacle in passing a straight and blunt pointed tenotome behind its tendon. You observe, therefore, that the safety of the operation depends on the tension of the muscle, and vice versa. And inasmuch as the sterno-mastoid muscle is not bound down by rigid fascial structure, as some others, its division can be usually rendered more safe than many other muscles in close proximity of vessels and nerves.

There is no objection to administering chloroform to the patient preparatory to the operation. But it sometimes happens that anæsthesis diminish the retraction of the muscle and thus obscures its contours. In such case we suggest the performance of the operation without it, or we first try mechanical means, inasmuch as the relaxation of the muscle under chloroform indicates that it has not as yet entirely lost its expansibility. We shall however return to this point.

The patient should be horizontally placed on a table, and the head brought in a position similar to that observed in tracheotomy. After the assistants have assumed their respective positions, you insert a pointed tenotome through skin and fascia and withdraw it. Next you introduce the blunt pointed knife. In using the same like a probe, you see that it passes through the punctured wound. You feel then the external margin of the muscle, and pass behind it sufficiently far to circumvent the clavicular portion, then you turn the cutting edge toward the tendon and divide it from within to without. If the deformity yields to redoubled extension, and you succeed in placing the head in proper position, the operation is finished; if not, you have to advance with the knife behind the sternal portion and divide that also in the same manner. From this description of the proceeding you notice that we enter the structures at the outside of the muscle, and you have accordingly to take your place. In dividing the left sterno-mastoid muscle you stand on the right and before the patient; for the other, you have to assume your place at the head, unless you can use with the same dexterity your left hand, in which case the former position may be retained. As to the proper place of division, it seems immaterial whether you sever the tendon nearer or more remote from its insertion. We chose the place where the tendon when properly tensified is best isolated, and hence most easily accessible. Again, if you anticipate the necessity of dividing both insertions it may be prudent to choose a long bladed tenotome so as to obviate a new entrance nearer to the sternal end.

The after treatment is plain, and comprises the use of the means previously alluded to. A stiff necktie is mostly all that we employ in our practice, and we have had fair success with the same.

As to the division of the scaleni or other more deeply-seated muscles of the neck, we shall have another opportunity for discussion.

Some of the casual deformities of the cervical region are of a spastic character, periodical in their appearance, limited in extent, troublesome in duration and scarcely amenable to any other than surgical treatment. We have seen but a few cases of that description, but judging from the numerous records of like cases, we entertain no doubt as to their frequency.

Their causation is mostly obscure. Sometimes direct injury upon the cervical portion of the spine

by fall or blow, or a previous concussion of the spinal cord may be charged with being the cause of the trouble. In others we may discover hyperæsthesia of the same organ, but whether this be the cause or the result we are often at a loss to determine. In exceptional instances a prior choreal affection in childhood has continued to later years. Mental effects, the repeated sights of epileptic patients and hysteria are likewise suspected as remote causes. And still oftener no cause at all can be assigned.

Much is thus left to speculation and chance. All authors agree in the observation that but little or nothing can be achieved by the most diversified medicinal treatment; whether this be from the intricacy of the cases, the obscurity of their causation, or their habitual character, we feel not prepared to determine. On the other hand the orthopædic knife has, in many cases, been found a serviceable, and in some the only remedy. Hence a new field has been opened to orthopædic exploits, and to a certain extent that field has been successfully broken. In order to maintain the rising credit of tenotomy and myotomy in this class of ailments, we should strictly qualify their indications. We believe that the operation should be reserved for old cases and those in which but the superficial stratum of the cervical muscles is implicated. It would be unwise to resort to operative measures in recent troubles of this kind and before the spasm has become stereotypical, for milder remedies may suffice or the spasm may yet change from one group to another.

Why the deeper muscular strata should be precluded from the use of the knife is self-evident.

The diagnosis, although generally easy, may occasionally be difficult with reference to the exact seat and extent of the clonic spasms, more especially when the deeper muscular strata are involved. For it is a well known fact that the affection does not always display the same degree of violence in different muscles, nay, even in the different parts of one and the same muscle. Thus the more intense spastic contraction of one muscle would naturally obscure that of another less agitated one. And again, the spasm successfully overcome by the knife in one muscle may soon reappear in another. All these circumstances should teach us precaution as to the prognosis.

Inasmuch as we have already acquainted you with the method of performing tenotomy and myotomy, we shall lose no time at this juncture with superfluous repetitions. A surgeon who is not capable of appropriating principles or technical maxims in new exigencies without somebody else doing it for him, is scarcely fit for that responsible position. But that you may fully understand the sort of cases we have in view in our discourse, and their management, we propose briefly to sketch some in illustration.

1. In April, 1836, Stromeyer took charge of the case of a lady, then some 30 years of age. As a child she had enjoyed good health. During infancy she had been a casual witness of the acquired epileptic paroxysms of her brother. But for a short period she had been affected with eczema of the hands. Later, her nervous system had exhibited an increasing excitability without giving her however any serious trouble. About seven years previously, the patient was noticed to incline her head toward the shoulder, which was however set down as affectation. In the spring of 1835 the patient experienced a sudden fright, and from that time the spasms became more apparent, and gradually increased in vehemence. When Stromeyer first saw her he found her in a reclining position on a sofa, the head being carefully supported by pillows. On rising, the distortions became manifest. The head was, with sudden jerks, pulled toward the left shoulder, so as almost to touch it, whereas the face was turned to the right so that the left ear came almost in contact with the sternum. The left side of the face became distorted, the left eyeball protruded, and the countenance manifested the expression of terror. In a few seconds the spasms subsided and the head could be borne erect, in order to return again with the same vehemence in about the same space of time. Whilst the spasms lasted it could be clearly discerned that they were located in the sterno-mastoid muscle, which shortened to the half of its length and projected with its contours accordingly. Mental excitement and local irritation would augment the ephemeral contractions, whereas extension would diminish or even prevent them, though causing painful sensations along the affected muscle. During sleep the spasm became quiescent.

Although for a year forced to a reclining position, and deprived of out-door exercises, yet her general health had suffered but little. Her nervous system exhibited of course that excitability which is usually coupled with such troubles. The patient had been subject to various medicinal treatment, the use of mineral waters, etc., but she had derived not the smallest amelioration therefrom.

On the 26th of April, Stromeyer subcutaneously divided the sternal portion of the affected muscle, in which the spasm seemed to be centred.

The momentary relief was most striking. The spasm at once subsided, and the patient could easily control the position of the head. Nevertheless, and in spite of subsequent extension by an appropriate apparatus, the spasms recurred in the undivided portion of that muscle. On the 26th of May, the sternal extremity was likewise divided. The patient now quite relieved, went into the country "rejoicing," and took Driburg Spa as an after treatment. In September she returned with new spastic agitation at the cervical region, in which, however, the reunited sterno mastoid muscle took no part. The examination disclosed the clavicular portion of the trapezius muscle concerned in the automatic movements. The division of that stratum removed the last vestige of the trouble.

For a similar affliction of a merchant, BUJALSKY, in Petersburg, excised pieces out of the two external branches of the accessory nerve with but temporary relief.

AMUSSAT'S case, *Gazette Médicale*, Dec. 1834, No. 52, presents great similarity with that of STROMEYER. The case had been of six years duration, and the affected sterno-mastoid muscle had become substantially hypertrophied, when the author divided the same. The result was instantaneous and lasting.

One of our cases occurred in a justice, 55 years old. The clonic spasms of both trapezius muscles had existed for three years when we took charge of it. Its cause was doubtful; whether from rheumatism or the removal of a lipome from the right suprascapular region, or any other cause, could not be satisfactorily determined. The general health of the patient had not suffered. The spasms had once ceased during an attack of typhoid, but recurred with convalescence. They became likewise suspended whilst the patient was asleep. All sorts of treatment had been vainly tried. The subcutaneous division of the affected muscles afforded permanent relief.

The other case comprised the right cervical muscles in a middle aged gentleman, and was likewise of several years duration. A fall with the cervical region upon a projecting substance had evidently been the cause of the affliction. The spastic movements of his head were twofold, rotatory toward the left and strongly inclining toward his right shoulder. They seemed to emanate from the right sterno-mastoid and platysma-myoides muscles. But the division of them brought but an indifferent amelioration, on account of the deeper muscular strata being likewise involved. Thereupon we proceeded to divide the scaleni muscles, which were the most tense under extension. We commenced the operation by a three inch long incision at the external margin of the sterno-mastoid muscle, and near its thoracic insertion. Having divided the fascia in the usual way, we cautiously dissected the subjacent connective tissue and fat, employing scissor, director and scalpel handle in preference to the knife. Thus we approximated the scalenus anticus which presented its contours in the base of the wound. Next we isolated that muscle behind, placed it upon the director, and divided it half an inch above the passing subclavian artery. Becoming however convinced that the deeper cervical muscles took part in the spastic distortions, we rested there with our operation. The wound gave us no trouble; no hemorrhage attended the proceeding. The patient was by no means cured, but so materially benefited that we had no cause to regret the operative attempt. As far as we have been able to trace the patient's whereabouts, we have ascertained that the violence of the spasm has been effectually broken, and that he is now able to control the remaining inconvenience by a stiff necktie made of leather.

GENTLEMEN: We regret to announce that the time allotted for these lectures has expired, and that the advanced season forces us to drop the subject where we left it at our last meeting. An apology is scarcely needed in reference to the deformities of the upper extremities, which we have omitted, for their pathology and treatment can be brought down to the same principles and maxims we have delineated on previous occasions.

What we do regret is, that we have to refrain for the present from the pleasure of imparting to you the knowledge of the so-called osteotomic and osteoplastic operations, mainly of German origin and culture. These operations form a most interesting and not the less practical chapter in orthopædic surgery; they are comparatively novel on this side the Atlantic, and almost indispensable in aggravated rachitic deformities of the cylindrical bones. However, the present postponement of that subject shall not deprive you of a future opportunity to render yourselves conversant with it, for we purpose to resume our lectures at the earliest convenience.

Nobody can be more sensible of the brief and fragmentary form in which our discourse has been carried on. But, gentlemen, lectures cannot give you literary completeness without becoming excessively tedious and pedantic. Lectures are not for reference but for immediate instruction. At all

events, cursory as our lectures have been from necessity, we have arduously labored to render them beneficial to you in a practical point of view. Sometimes it may have occurred to you that we made too strong efforts against popularized and received doctrines, and that we indulged in too severe criticism of the same. But, gentlemen, popular doctrines are but too often the most formidable obstacles to scientific advancement; they are the rubbish of past ages, obstructions, so to speak, which should be removed in order to clear the track for progress.

Next, you may think that we have been too earnest in putting forth our scientific and practical merits for the advancement of orthopædic surgery. But if others studiously withhold from us the just acknowledgement of our own literary property, and even worse, turn it to an account for personal ends, modesty would be ill-placed. Against plagiarism and false pretences, direct exposure seems to be the best protective, and if we have committed an error of judgment, it has certainly been on the side of delicacy in not lifting the veil from the names and actions of the literary Bedouins who have tried to deprive us of our just dues.

In parting from you we sincerely thank you for the diligent attention you have shown during the course of our lectures, and we do hope that you may derive some advantage in return of your devotion.

Since the closing of our lectures we had the misfortune to lose a patient afflicted with posterior curvature. For the last five years we had charge of her case and have closely observed the different phases through which she has passed. Having likewise secured the specimen of the affected spine and subjected the same to a careful examination, we are able to present a history of rare congruity, importance and interest, furnishing as it does a continuous commentary on the pathology and therapeutics advanced by the author in the preceding pages. The following addendum will, we feel persuaded, be acceptable to the reader.

Case of Kyphosis of more than six years' standing, complicated with motor-paralysis of lower extremities; relief of the latter and arrest of the disease for a period of four years; death from granular meningitis; interesting pathological disclosures; with three illustrations.

At the tender age of 2 years and 9 months the patient met with a fall. A short time after the accident the little girl exhibited some indefinite indisposition, inducing the parents to call upon Prof. Willard Parker. There were as yet no indications of an impending spinal trouble, nevertheless that sagacious surgeon rendered a clear diagnosis. Deriving however no encouragement from him as to the ultimate recovery of their offspring, the parents subsequently placed the child under the charge of Prof. Valentine Mott, who directed the ordinary treatment then in vogue, rather encouraging than disparaging locomotion. Among other remedies resorted to, issues close to the spine were established. For five months the treatment was scrupulously carried out, whilst the malady was steadily advancing. At last the treatment was suspended, and for ten months nothing was done to arrest or mitigate the affliction. Meanwhile the suffering of the patient had become unbearable, the deformity had greatly increased, and the locomotive power of the lower extremities so much impeded, that the parents again sought professional aid.

At this juncture we took charge of the case. The patient was then prostrate, attenuated and almost hydræmic. She was moderately feverish; cardiac action greatly excited; her respiration laborious, and her temper irritable. The angular deformity occupied the thoraco-lumbar portion of the spine, the first lumbar spinous process being the most prominent point. There was great tenderness about the spine, and such perfect motor paralysis of the lower half of the body that no stimulus excited the slightest reflex action. No traces of abscess could however be found in either lumbar or ileo-inguinal regions.

The early appearance of the deformity after the accident, its seat, rapid progress and angular shape left scarcely any doubt as to the cause of the trouble, namely, fracture in the body of either the twelfth thoracic or first lumbar vertebra. Under this impression the prognosis was certainly unfavorable, for all symptoms indicated structural and form-alterations of some vertebral bodies. Caries was at least impending, if it had not already commenced; new complications were thus threatening, irrespective of the already existing paraplegia. In fine, the constitutional force of the patient had already been broken down. There were consequently no prospects of recovery, even the arrest of the disease was more than problematical.

Nevertheless, whatever might be the eventual results of the treatment, the actual sufferings of the patient demanded some palliatives. Horizontal posture upon a water bed, moderate local depletion, inunctions with Ung. Hydrargyri, and of course generous diet, were insisted on and readily complied with.

We should not have been surprised to see the patient somewhat relieved by this treatment, but our expectation was greatly exceeded both by the rapidity and extent of her improvement, so much so indeed, that we became skeptic of our diagnosis. The ameliorations at the end of the eighth month may be briefly summed up as follows: Regularity of all vital functions, excellent appetite and rest, satisfactory appearance, increased weight (by five pounds), entire immunity from pain, locomotion of lower extremities almost re-established to perfection.

During this period we had already applied the spinal splint, allowed the patient to creep about on knees and elbows, and to be taken into the open air. At the end of the same, presuming that a most *unexpected consolidation* of the spine had been achieved, we ordered a spinal supporter closely fitting to the cast then taken, (Fig. 52.) and suffered the patient to take cautious and moderate exercises, frequently interrupted by rest in the recumbent posture. The first attempts of this description were however so satisfactory in their bearing, that very soon we removed all restrictions and allowed the child to do whatever she pleased.

Four years the patient was thus doing well. Although we frequently saw the patient, yet we had no occasion to call upon her professionally again until last Spring, when she had suddenly been taken sick. Without enlarging on the details of her late illness, suffice it to say that she suffered from, and eventually died of meningitis cerebralic exudativa.

Fortunately the enlightened parents felt the same interest in the character of the case, that I did, and therefore readily consented to the autopsy, which was made twenty-four hours after death.

The general appearance of the body, especially the state of her nutrition, was satisfactory considering that it had just passed through a course of sickness during which but little food had been taken. There was intense arachnitis with widely scattered granular eminences, made up however of connective tissue; the disease did not extend into the spinal canal, though the brain and cervical portion of spinal cord were in a state of hyperæmia. Thorough search for tubercular deposits in other organs ended in a negative result. That fragment of the spine concerned in the disease having been removed and longitudinally divided, disclosed, indeed, a pathological condition which we were not prepared to find. We annex illustrations of this and another important specimen, that their comparative value may be realized.

The former (A. B.) consists of the six inferior thoracic, the second and third lumbar vertebræ, besides fragments of the first four lumbar ones. To the left half of the specimen the corresponding portion of the spinal cord is still attached. (1.) The angular infraction of the spine locates exactly at the remnant of the first lumbar vertebra. On raising the cord it may be noticed that the bend of the spine leaves the spinal canal free from any encroachment or obstruction whatever. Nor is any morbid change presented by either the cord or its membranes.

Anteriorly and laterally the lower portion of the specimen is surrounded by a large complement of firm connective tissue (2), obviously restraining the otherwise inevitable mobility of the infracted spine. The adjacent soft parts show no indication whatever of suppuration. Whilst with one exception all intervertebral fibro-cartilages are completely healthy, the body of the first lumbar vertebra is almost totally, and that of the twelfth thoracic partially destroyed, and the remaining ones exhibit more or less large cavities (3) filled with a yellow semi-solid material. All these cavities are located close to the dura mater (4), and in some that membrane supplies the posterior wall of the same. Whether the cancellated structure of the vertebral bodies had slightly suffered from osteoporosis we are uncertain; that of the twelfth dorsal was rather densified from plastic-infiltration. In the fresh state a moderate hyperæmia of the spine could be clearly discerned.

As has been mentioned, two of the vertebral bodies had substantially suffered in both shape and size. Of the body of the first lumbar vertebra, but a posterior fragment (5) has remained, and even from this a smaller piece (6) has become so completely detached that it can be taken out of its crummy bed and replaced. Anteriorly to the fragment a tolerably large cavity (7) exists, which we found filled with a similar material as the cavities of the bodies. Of the body of the twelfth thoracic vertebra, but a small fragment is missing; its form has then become deficient in a diagonal direction (8) as if a small wedge had been chipped off from the anterior and lower portion. Exceedingly interesting is the relation between the remnants of the two bodies. The lower surface of the upper vertebra rests upon the anterior of the lower in almost a right angle. But it would seem as if the upper surface of the first lumbar vertebra had inclined forward and downward, in which case the cancellated structure must have previously caved in. Between the two the intervertebral disk is completely destroyed.

The reader may readily imagine that we felt the most intense interest to get at the real nature and composition of that yellow semi-solid material that filled the osseous caverns. At the first glance it presented itself as tubercular deposit par excellence, and this very appearance made us still more tenacious in ferreting out its character. Whilst we engaged in the microscopic examination of one, we sent the other half of the specimen to a gentleman in New York, whose profound knowledge in pathological anatomy, and dexterity in the use of the microscope has perhaps no superior in this country. To prevent misunderstanding, we accompanied the specimen with a note, setting forth that we requested his opinion as an expert on the question, Whether that material was tubercle or changed pus?

Great, indeed, was our discomfiture when that gentleman sent us an answer to the effect "that it needed no microscope to recognize the tubercular material of the specimen."

In spite of our deference for that opinion, we nevertheless continued our own investigation, which resulted in a widely different conclusion. The subject being however of too great importance to rely on our observation exclusively, we requested Prof. Alonzo Clark to lend us his assistance, which he courteously granted. In an examination of more than an hour, instituted with that care and circumspection which so eminently distinguishes that gentleman, the fact was indisputably established *that the material in question was bona fide pus in a state of condensation and fatty degeneration.*

Another question at once grows out of that decision, namely, *how are the multilocular abscesses in the vertebral bodies to be accounted for?* The answer is much easier than might be imagined. For all the abscesses are placed in close proximity to the spinal dura mater; some of them open upon it. Subjacent to that membrane and along the anterior wall of the spinal canal a similar material can be traced, which connects, as it were, the abscesses all along the spine. We infer therefore that the purulent material in the place of any other outlet, moved up and downward between the dura mater and the anterior wall of the osseous spinal canal, causing the multilocular abscess and eventually undergoing all the changes simultaneously with their contents. This would seem the only explanation admissible.

During the suppurative process the quantity of pus that raised the dura mater from the spine, the spinal cord must have been compressed or have suffered from irritation and hence the paraplegia. Thus the pathology of the case seems clear and plausible. Yet other points need mention.

In the first place were we right in presuming a fracture as the cause of the deformity? After a due deliberation of all circumstances attending our case, we cannot be induced to change the previous diagnosis. For the existing mischief is by no means incompatible with the same, irrespective of the arguments already set forth. We have repeatedly stated in our lectures that the thoraco-lumbar region of the spine is very susceptible to fracture, and that a wedge shaped fragment may be easily chipped off in front and below a vertebral body. This has been demonstrated by experiments and autopsies. If the fracture is disregarded and the patient continues locomotion, the fragment is displaced anteriorly and the spine bent backward. The former may or may not become agglutinated in the new position. In the latter case it may be turned into a sequestrum and thus give rise like every other foreign body, to local irritation, suppuration, caries of the adjacent bony structures, and in fine, lead to exactly the very same consequences with which we had to grapple in concreto.

Next, which of the vertebral bodies had been fractured? In glancing at the specimen it will be found that the twelfth thoracic one exhibits exactly the form in which the ordinary fracture would leave it, that is to say, the body is defective to the extent of a small wedge removed anteriorly and inferiorly. Caries of the fractured surface may have slightly increased the defect, but the type is still visible. The greater destruction of the first lumbar vertebral body may be thus accounted for, that the bony fragment remained in connection with the lower fibro-cartilage, that therefore the irritation arising from that source was more readily transmitted to the structures to which it was attached, and that in fine the matter would more readily descend than ascend. Thus the body of the lumbar vertebra had been macerated in pus, and eventually disintegrated. There is likewise a possibility that the fracture extended at once through both implicated vertebral bodies down to the subjacent fibro cartilage. If we elongate the line from the face of the twelve thoracic vertebræ through the first lumbar, it would terminate at least 2‴ from the spinal canal. Such a supposition is however scarcely tenable, since the posterior curvature must have been instantaneous and at once considerable.

Again, it seems singular that suppuration to that extent, provoked and maintained by foreign bodies

as it were, should have existed without external manifestation, and moreover, should have come to a spontaneous stand-still for so long a period as four years. Facts like these do not often present themselves in the ordinary range of surgical observation. Some suggestions occur to our mind which may tend to render those facts more transparent and intelligible.

As an ordinary observation it must be admitted that the quantity of pus produced by bone disease is comparatively but trifling. Bona fide bone abscesses are never large, and the pus is mostly of good quality. Its decomposition is brought on by access of atmospheric air. Moreover, as shown by Gurlt, the pus of bones has a great susceptibility to be converted into a soft cheese-like substance, hence its being confounded with tubercular deposits.

We have at present a little boy in treatment for posterior curvature, who has had for the last nine months an ileo-lumbar abscess of considerable size without disturbing him. In the beginning, the quantity of pus could not have been less than a pint, besides being very fluid. During the last three months the size of the abscess has obviously diminished, whilst its contents have become more condensated and its walls thickened. Similar observations other surgeons have made in the like cases. In the same ratio as the bone pus becomes mixed up with the detritus of other structures, or decomposed, it certainly assumes a more caustic and therefore destructive character, so as to corrode even the integuments, despite of their epithelial protection.

In the present case we had purely bone pus, formed by healthy osseous structure; it was consequently of an indifferent and mild character and therefore not apt to carry great destruction in its course. Six years were thus required to disintegrate a single vertebral body, although most exposed, whereas in more remote locations it just sufficed to cause comparatively superficial excavations.

Inasmuch as the purulent flow entered the spinal canal and diffused anteriorly between dura mater and spine, it may be reasonably inferred that the previous paraplegia of the patient had derived its cause from that source either by mechanical or dynamic effect.

As soon as the local irritation was stopped by reclination of the patient, the suppuration of the affected spine became virtually arrested and nature at once initiated the process of repair, so clearly demonstrated by the specimen. Nothing seems to have been in the way to perfect recovery as far as the local disease is concerned.

In comparing the specimen (A. B.) with another specimen (C.) on the plate, it must be conceded that the pathological conditions disclosed are of a very different cast. In A B, the cancellated structure is preeminently affected; in C the intervertebral cartilage has suffered most, whereas the osseous structure is scarcely touched. The last illustration represents the specimen we have referred to in Fig. 49 of our lectures.

Thus we have demonstrated, as we hope to the satisfaction of the reader, the fact that different causes underlie the posterior curvatures, and that it is impossible to substitute Delpech's hypothesis for pathological realities.

The comparative results attained by different modes of treatment speak for themselves. Under the former the disease steadily advanced, both locally and constitutionally; in the latter the patient improved, recovered locomotion and a relative state of health. What more is needed than the specimens themselves, to prove that issues are inoperative in the like structural lesion growing out of mechanical derangements. And a mere glance at those conditions must satisfy the most skeptic mind that the superstructure of the body cannot be borne erect by a foundation so utterly disqualified.

The publication of this case has but the object of contributing to the correct understanding of the pathology of kyphosis, which alone should govern the healing art, and is not intended to reflect on the professional views and curative maxims of a venerable Nestor of our profession, of whose merits for the promotion of surgery none can have a more exalted appreciation than the author.

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